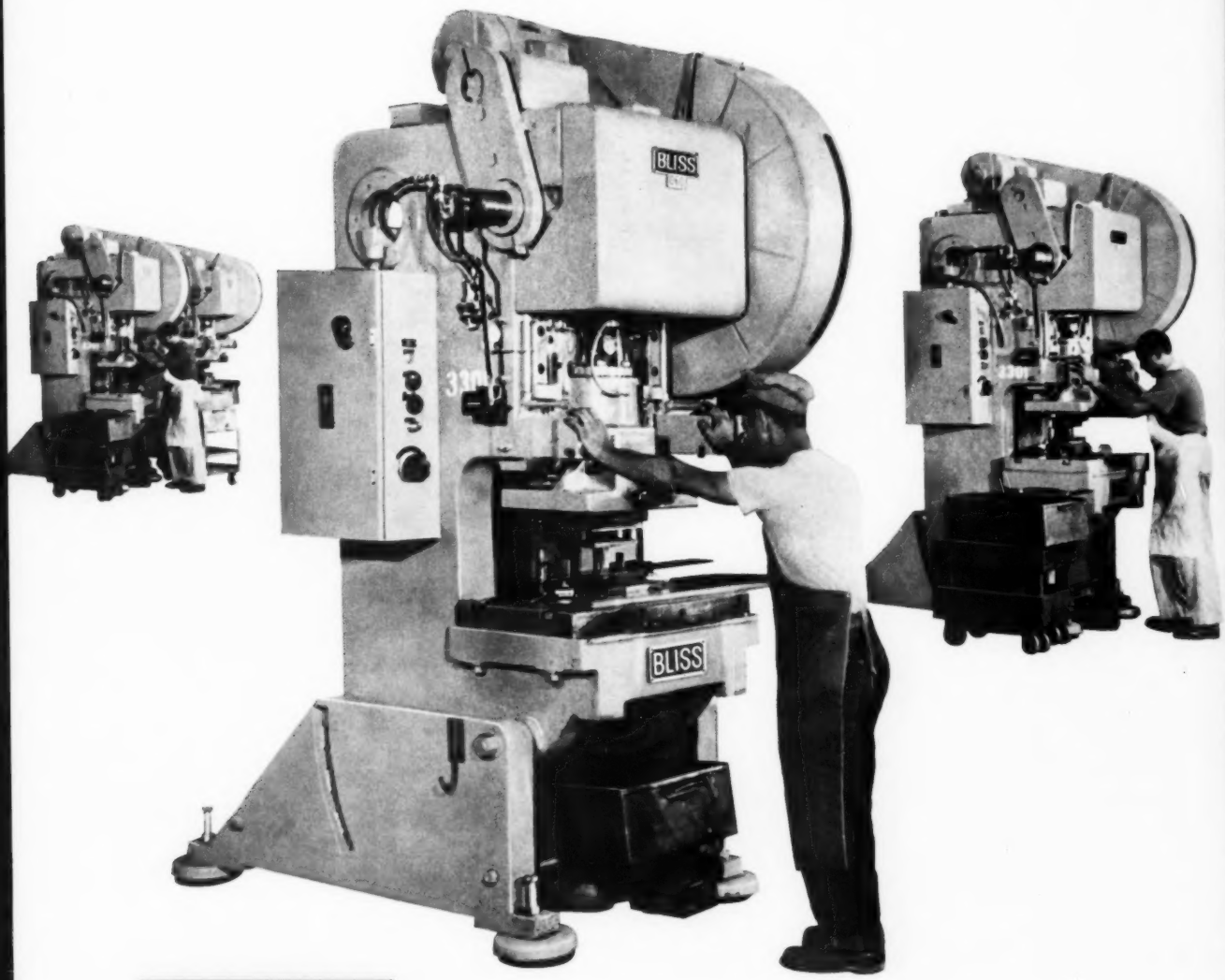
ENGINEERING AND PRODUCTION IN METALWORKING FEBRUARY, 1961

Machinery



BLISS
SINCE 1857 ®

New Bliss "C" Inclinables take front seat at American Seating . . .

(See advertisement, page 51)

UNIVERSAL GRINDING

Reversing the Cost Trend

by Clifford G. Menard
Consulting Engineer
The Heald Machine Company

Just about everything costs *more* these days—*much* more than it did 10 or 15 years ago. And when we first decided to build a completely new Universal Internal Grinding Machine that would not only "hold the line", but actually *reverse* the upward cost trend, many an eyebrow was lifted in disbelief. Some said it couldn't be done. Others felt that major economies could be made only with a big sacrifice in performance.

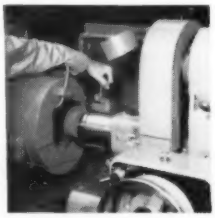
Admittedly, the task was not a simple one. In order to cut costs without cutting quality, we had to make a complete re-evaluation not only of the basic machine design, but of every step of our manufacturing operations as well. But we found that a large number of cost savings could be made, by utilizing the latest advances in machine design and streamlining production methods to eliminate as many manual operations as possible. Although most of the savings were relatively small individually, they added up to a major reduction in manufacturing cost.

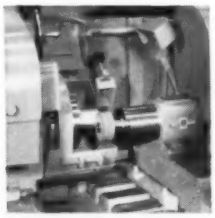
This better, more versatile general purpose grinder costs about *half* as much as comparable machines today, and *less* than similar machines (with fewer features) cost in 1947!

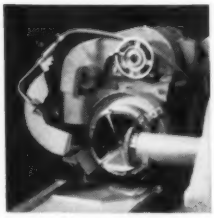
Here's how some of the savings were made. The use of hydrostatic table ways eliminated an expensive booster arrangement in the hand table feed. An externally-mounted valve "package", on the front of the machine, simplified the hydraulic power arrangement and eliminated all but essential units in the hydraulic system. And with all hydraulics outside of the machine, the base is mechanically stronger and less expensive to produce because there are fewer holes and less surface area to finish. Furthermore, simplified basic engineering and construction make it possible to build this standard machine with standard arrangement on a STOCK basis resulting in shorter deliveries.

These and other refinements enabled us to make the 273A a truly universal machine with greater capacity, easier operation, and inherent precision that holds tolerances within .0001″ in normal production and .000050″ in special cases. Yet its 1947 price tag puts it within the economic reach of virtually every plant or machine shop, regardless of size.

Here's the new Model 273A Universal, on display at the 1960 Machine Tool Exposition. On a steel test piece, the O.D., a straight bore, a tapered bore and the face were ground to size within .0001″ at a single chucking.







Workhead swivel of 90°, several wheelhead positions, permit I.D., O.D. and rotary surface grinding of parts up to 12″ in diameter. Vari-speed workhead drive is infinitely adjustable from 75 to 450 rpm.

Ask your Heald Engineer for the complete UNIVERSAL story. Then compare its performance and cost with any other similar machine available today!

THE HEALD MACHINE COMPANY
Subsidiary of The Cincinnati Milling Machine Co.
Worcester 6, Massachusetts

FEBRUARY 1961

VOL. 67 No. 6

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Machinery

THE MONTHLY MAGAZINE OF ENGINEERING AND PRODUCTION IN THE MANUFACTURE OF METAL PRODUCTS

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GENERAL ELECTRIC COMPANY

reduces threading costs on short run

The new LAN-NU-ROL Thread Rolling Machine has provided improvements in thread quality and substantial reductions in threading cost on job lots of 1 to 1000 studs at the General Electric plant in Lynchburg, Va.

THREAD SPECIFICATIONS

Workpiece:	Selenium Rectifier Mounting Studs being run in lot sizes from 1 to 1000 on 120 Brinell steel (see cut-away illustration of rectifier showing location of stud).
Lengths:	From 1" to 16"
Sizes:	#6, #8, #10—32 pitch ¼"—20 pitch, 5/16"—18 pitch, ⅜"—16 pitch
Class:	2A
Rolling Speed:	340 R.P.M. (all sizes)

Being able to run all sizes and diameters on the Lan-nu-rol alone proved the worth of the machine. However, the advantages of the Lan-nu-rol over the machine of another make previously used for this operation are many. The exclusion of several operations and equipment plus eliminating the need for purchasing certain sizes of pre-threaded bar stock were important Lan-nu-rol benefits. Thus, by using the Lan-nu-rol, the previous disadvantages have been supplanted by the following advantages:

- 50% reduction in set-up time.
- Constant size control of work allows for use of mill run or warehouse cold drawn stock instead of precision ground stock—an approximate reduction in cost of 50%.
- Better quality—not one defective or rejectable stud traced to the Lan-nu-rol.
- Eliminated process inspection—better size control and better quality eliminates 100% inspection of parts . . . now on first piece basis only.
- Direct labor reduced 50%.
- Increased production.

The Lan-nu-rol machine produces threads by the chipless cold-forming process. It will thread all diameters up to 2" by In-feed Rolling and up to 1" by Thru-Feed Rolling, depending on workpiece material and thread specifications. The Lan-nu-rol can be equipped with automatic feeding for thrufeed rolling and some types of infeed rolling applications. It will produce left- and right-hand threads including UNC, UNF, Acme, Worm, and many special forms. For additional information —please send specifications and ask for Bulletin E-101.

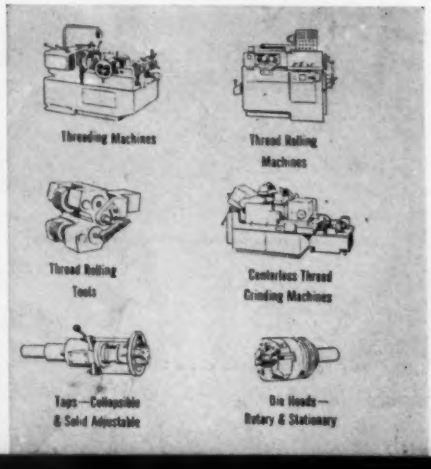
LANDIS *Machine* COMPANY

WAYNESBORO, PENNSYLVANIA

THE WORLD'S LARGEST MANUFACTURER OF THREADING EQUIPMENT

531C

Larger threads—up to 3" in diameter may be rolled on the Lanhyrol Machine. A new machine is soon to be announced for rolling threads up to 6" in diameter.



how's this for high-speed hobbing?

WORK PIECE					HOB (1 start)				Pieces per Load	Method*	Time per Piece	Pieces per Grind	Cut
Dia. Pitch	No. of Teeth	Helix Angle	Face Width	Material	Dia.	RPM	Feet PM	Feed					
10	20	15°	1¾"	1040 leaded	3"	500	395	.055"	1	A	2 min. 25 sec.	150	Finish
7	23	13°	¾"	8620	4"	350	370	.100"	2	A and B	59 sec.	240	Pre-shave
5	43	24°	1⅝"	8620	4"	280	300	.100"	2	B	3 min. 45 sec.	80	Pre-shave

* *Method A: Diagonal Hobbing. Method B: Step-by-step Hobbing.*

This is the kind of performance you get with

THE FELLOWS-PFAUTER P400 HIGH-SPEED HOBBING MACHINE

HIGH-SPEED HOBBING. Performance speaks louder than words. The examples given above show the results of high-speed hobbing which can cut costs. The figures are taken from the records of typical production runs on the Fellows-Pfauter P400.

DESIGN. The P400 was designed for High-Speed Hobbing, and it features a new basic design. The individual machine elements are of maximum rigidity. The hob head is heavy and rugged, the machine column and bed are of double-wall construction with heavy V-ways and the work table is as large as the maximum permissible work piece diameter. The index worm gear is nearly as large as the work table, and the work support column is of massive construction. All parts of the machine are properly proportioned and of sturdy design to eliminate vibration. The cost is more than justified by the resulting reductions in hobbing times and the increased hob life.

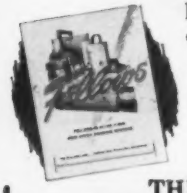
RIGIDITY and CLOSE TOLERANCES. The large size work table and index worm gear and the oversize hob head, which eliminates lead errors caused by hob breakout, are important factors in providing the rigidity necessary to hold work to close tolerances.

COMPLETELY OPEN WORKING AREA. The machine and the work-support columns are of such rigid construction that the hobbing stresses are absorbed without requiring an over-arm. Therefore the working area is easily accessible for set-up and work loading. The automatic retraction of the table from the hob also facilitates changing of work.

SET-UP TIMES and FLOOR-TO-FLOOR TIMES are reduced on the P400 because it has infinitely variable speeds and feeds, rapid traverses for all machine movements, including hob shifting manually by push button, and built-in hydraulics for the operation of the tailstock and simple hydraulic fixtures used on this machine.

AUTOMATION on the P400 is simple and fast. The illustrations show a machine equipped with automatic loading and unloading devices.

GEAR HOBBING COSTS can be cut by high-speed hobbing on a P400 because of the resulting savings in production time, floor space, maintenance and labor.



THE FELLOWS GEAR SHAPER COMPANY 78 River Street, Springfield, Vermont, U.S.A.

Branch Offices: 1048 North Woodward Ave., Royal Oak, Mich.
150 West Pleasant Ave., Maywood, N.J.
5835 West North Avenue, Chicago 39
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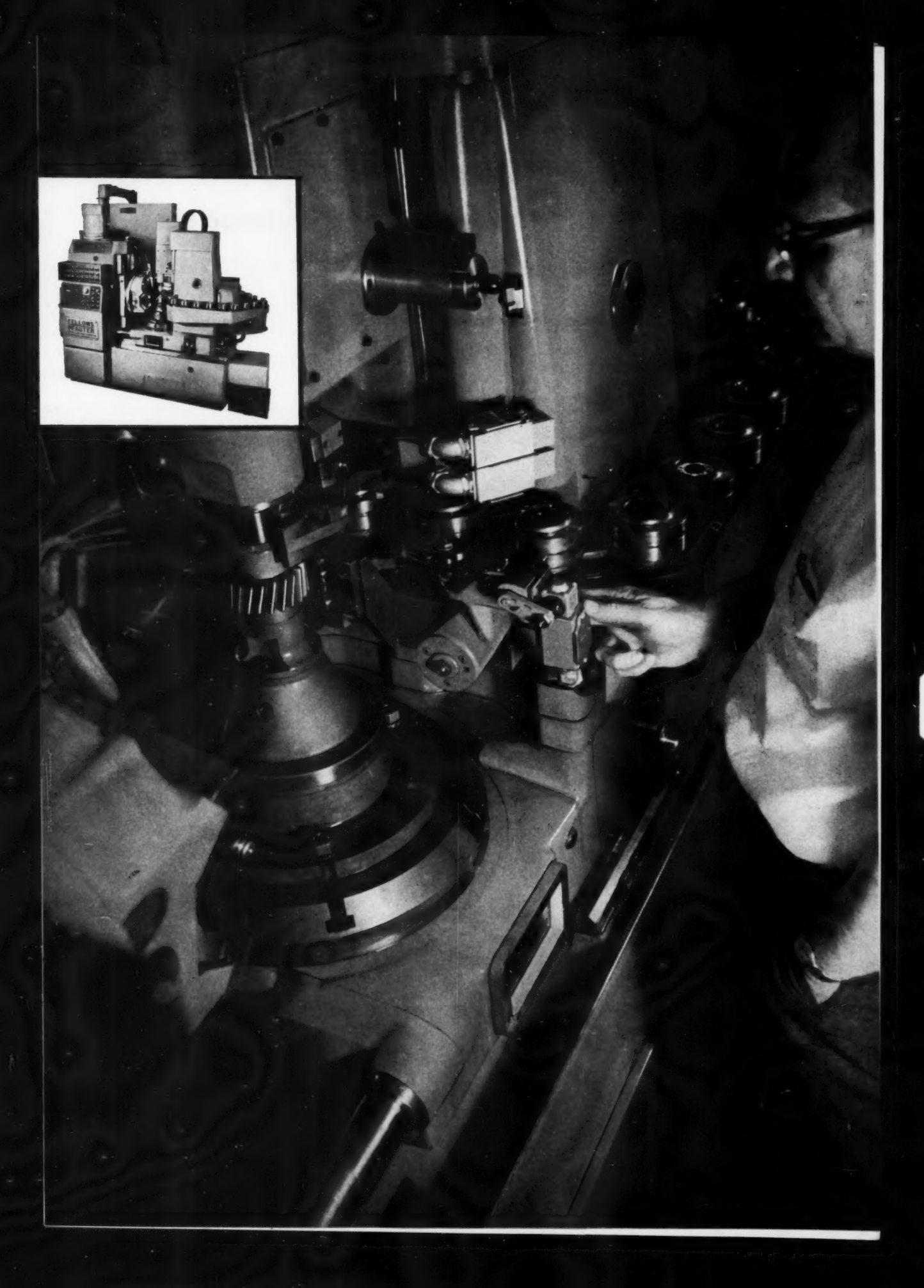
THE PRECISION LINE

Fellows

Gear Production Equipment

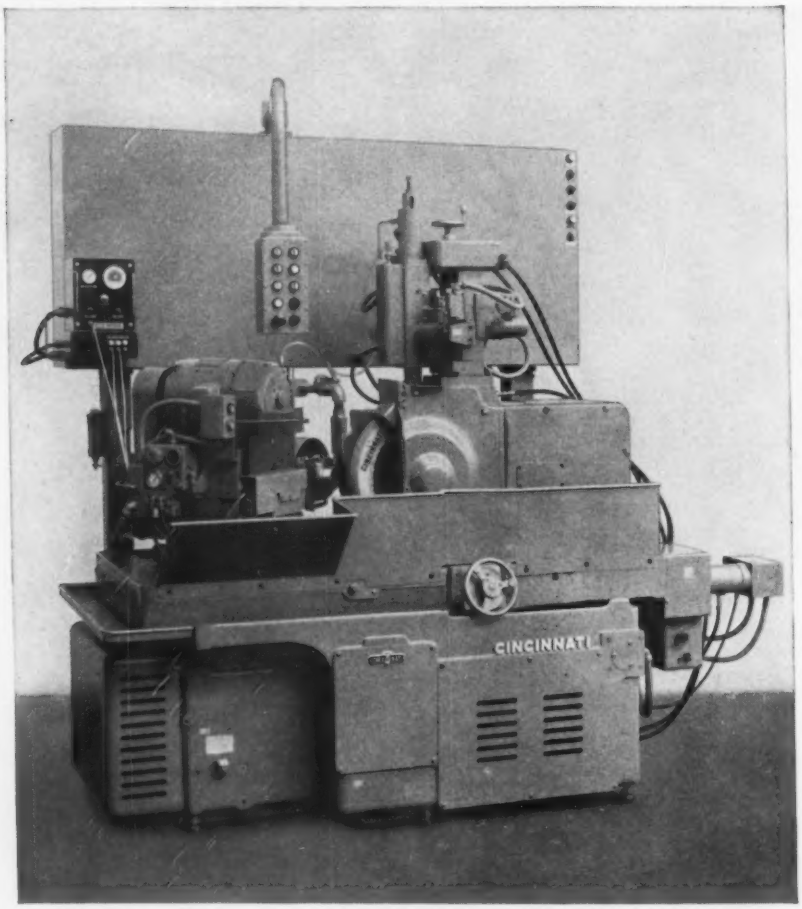


CINCINNATI COMBINES

SUPERIOR CHUCKING GRINDER PERFORMANCE

with WIDE VARIETY OF TOOLING

FILMATIC®



Production and quality are automatically controlled by the ingenious tooling and extra equipment, principally of standard design, on this CINCINNATI FILMATIC No. 2 Chucking Grinder. These fine precision grinders are built in two sizes:

No. 1—Capacity 0" to 4" diam.
No. 2—Capacity 2" to 10" diam.
Catalog No. G-685

BUILDERS OF PRECISION GRINDING MACHINES: CENTERTYPE • CENTERLESS • MICRO-CENTRIC

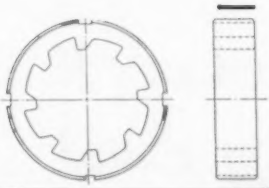
THE CINCINNATI MILLING MACHINE CO., CINCINNATI 9, OHIO

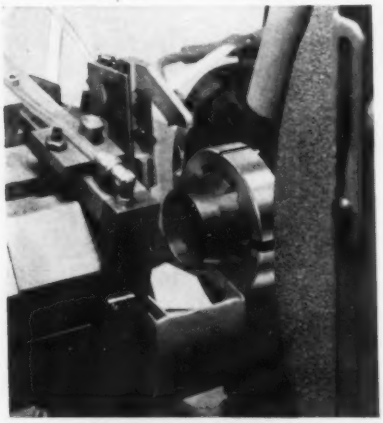
The chucking method of grinding is expanding. Cincinnati has given it a well-deserved forward push with superior engineering service and outstanding machines. Operations include the grinding of diameters, shoulders, bevels, faces and combinations thereof, in quantities of several hundred or millions.

These fine chucking grinders are built with single spindle or two-spindle headstocks to give you a choice of automatic or manual loading. They can readily be tooled up with a variety of positive chucking and work locating arrangements. Production equipment you'll want to know about includes automatic profile truing; crush truing; gap eliminator to reduce the time spent in "grinding air"; automatic cross feed compensation for wheel wear and truing.

Many unusual types of work are now recommended for the chucking method of precision grinding. Examples which have been tooled up by Cincinnati are illustrated here. Many more, and complete specifications, will be found in catalog No. G-685. May we send you a copy?

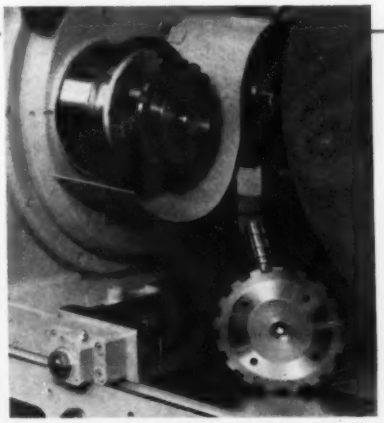
CINCINNATI





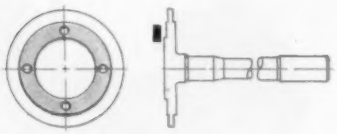
Single spindle, automatic production. Equipment includes air-electric gage sizing, cross slide compensation, automatic loading, etc. Black line in part drawing indicates ground diameter.

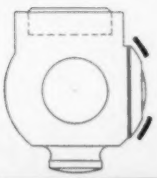
Part name ..... Clutch race
Operation ..... Grind O.D.
Material ..... Steel
Production ..... 192 per hour

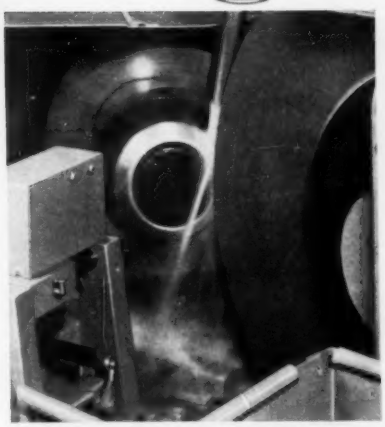


Two-spindle headstock facilitates loading. Production items: automatic truing including cycle counter, gap eliminator to reduce time spent in "grinding air." Finished ground part is shown in foreground. Black line and shaded area in part drawings indicate ground surface.

Part name ..... Output shaft
Operation ..... Grind face
Material ..... Steel
Production ..... 120 per hour







Single spindle heavy duty headstock, automatic grinding cycle, pneumatic chuck with interchangeable jaws are combined to grind 13 sizes of parts. Black line in part drawing indicates ground surface.

Part name ..... Valve core
Operation ..... Grind radius on seat
Material ..... Stellite hard facing
Production ..... 20 to 35 per hour, depending upon size

• ROLL • CHUCKING • CENTERLESS LAPPING

CINCINNATI®
GRINDING MACHINE DIVISION

For more data circle this page number on card at back of book

HIGH WHEEL SPEEDS ?

Over the years Landis has supplied many cylindrical grinders with high wheel speeds... but only to fit the job requirement.

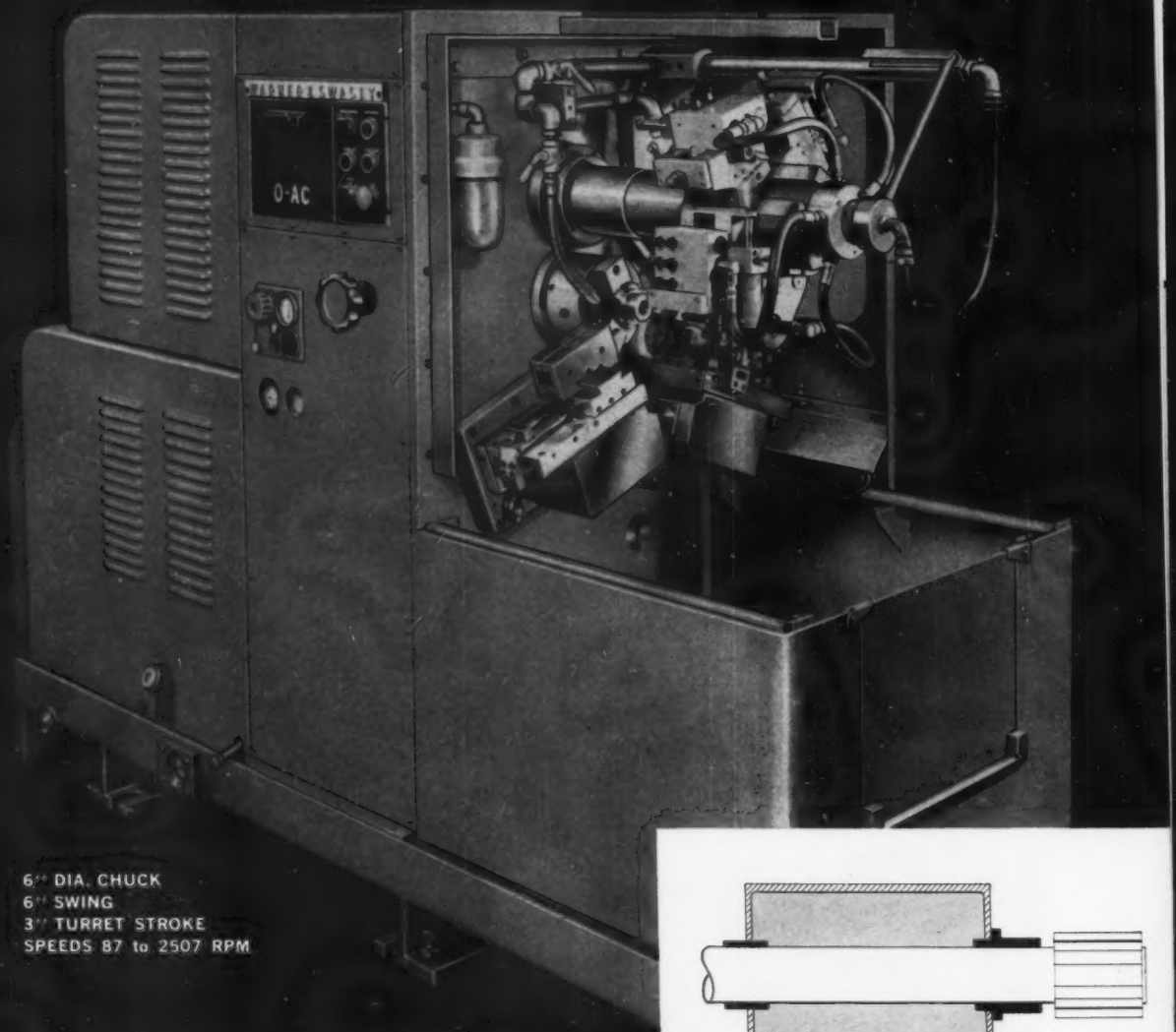
If you need 8500 SFPM on your next Landis grinder, it is available. As always, our engineers will recommend the best speed to grind your workpieces efficiently.

LANDIS

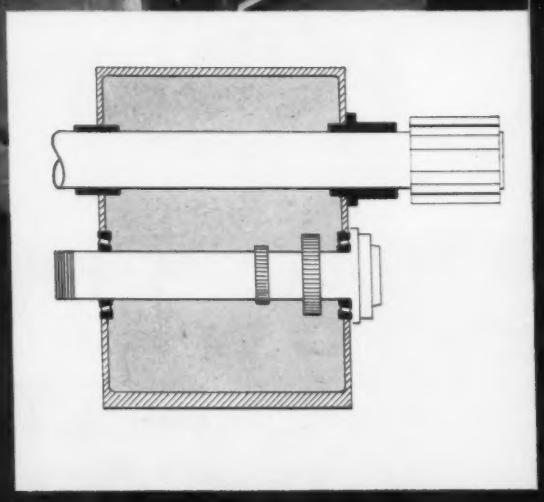
world leader in precision grinders

LANDIS TOOL COMPANY / WAYNESBORO, PA.

NOW YOU CAN AUTOMATE PRODUCTION



6" DIA. CHUCK
6" SWING
3" TURRET STROKE
SPEEDS 87 to 2507 RPM



Spindle rise has been practically eliminated in the O-AC by placing the spindle and turret bearings in the same housing where they are subjected to exactly the same temperature, and continually lubricated with clean, filtered oil.

OF SMALL PRECISION PARTS with the New Warner & Swasey O-AC Single Spindle Chucking Automatic

Warner & Swasey's newest addition to its proven line of Single Spindle Chucking Automatics — the O-AC — is specifically designed to automate the production of small precision parts in all lot sizes — even as few as 30 or 40 pieces.

SMALL LOTS are profitable on the O-AC because it sets up fast and can be changed from job to job quickly and easily. There are no cams to design, change or store. The tooling area is uncluttered, easy to get to for faster cutter setting and adjustments.

PRECISION work piece tolerances and fine finishes on a repetitive piece-after-piece automatic basis are routine for this new single spindle chucker. Because of its unique overhead turret construction, only the O-AC can assure this high degree of production accuracy.

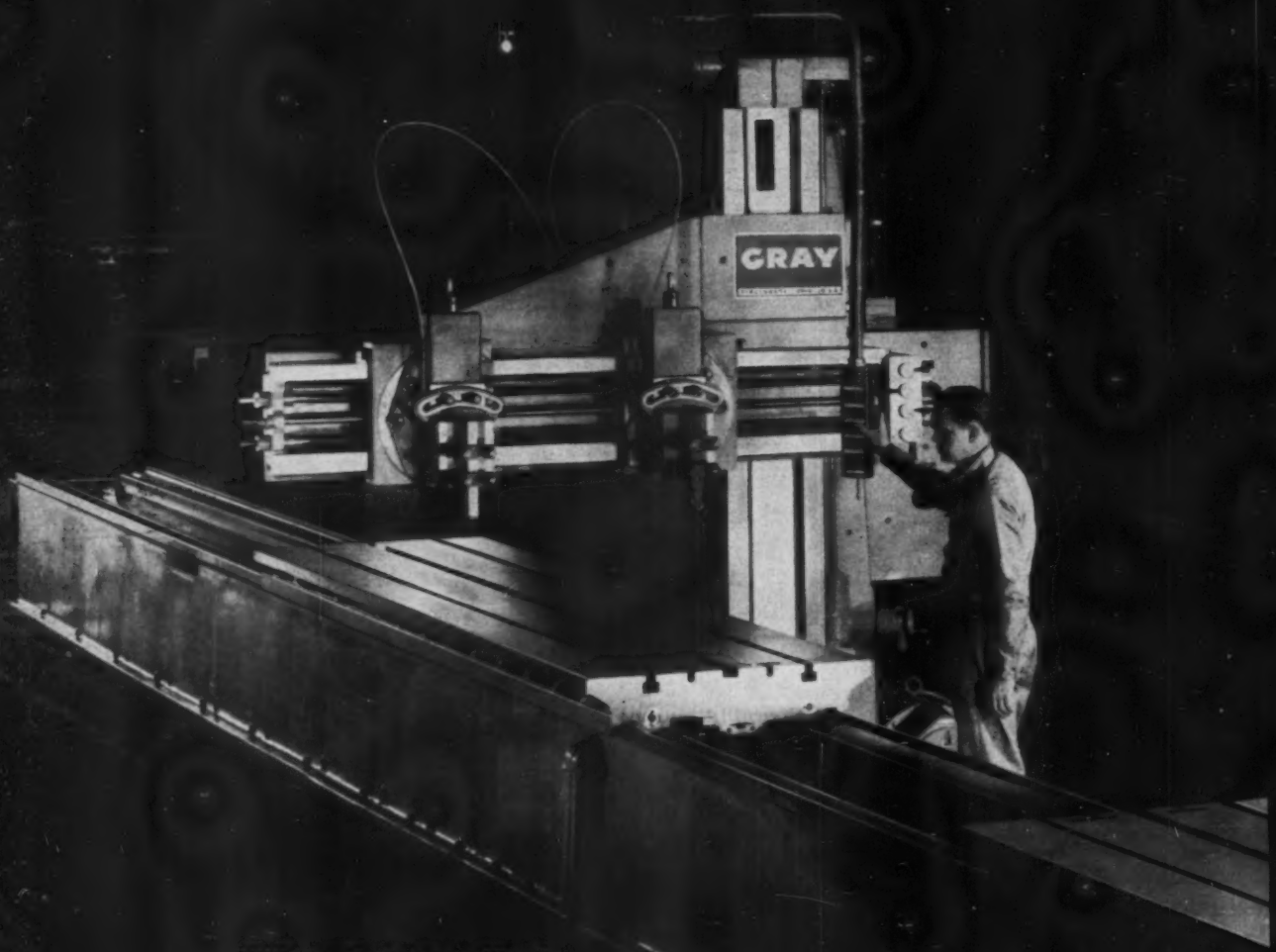
VERSATILE PERFORMANCE results from the O-AC's unique tool slide actions. A wide range of work — from ordinary small castings to complicated missile components — is efficiently handled, usually with low-cost standard tooling.

Your Warner & Swasey Field Engineer has the complete facts on the new O-AC ready for you. Or write us direct, Warner & Swasey Co., Cleveland 3, Ohio.

All automatic functions are rapidly set up by the simple placement of trip blocks and switch operating screws. All automatic functions can be individually hand controlled during setup and switched to "automatic" or back to "hand" at any time with a single control switch.

YOU CAN PRODUCE IT BETTER, FASTER, FOR LESS...WITH A WARNER & SWASEY

For more data circle this page number on card at back of book



GRAY Flying Scot above is 42" x 28'
with two rail heads
and special duplex table.

26 page Bulletin No. 73
on GRAY Flying Scot
available
on request

The G. A. Gray Co. / Cincinnati / Ohio /

What makes the $30,660* GRAY a best seller?

The 30"—36"—42" GRAY Flying Scot can lick any planer its size, in price or performance. It packs more value per dollar than any planer ever built. It is perfectly constructed, down to the smallest component, exactly like every Gray machine. It will perform — precisely — for years. Carbide planing up to 300 ft. per minute makes it the world's highest production small planer. Optional features, like double cutting and a duplex table, increase its productivity — and your hourly profit. Over (15) have been purchased since first introduced in May 1960.

*Basic price of 30" x 6' Flying Scot one rail head, electric drive, and controls.

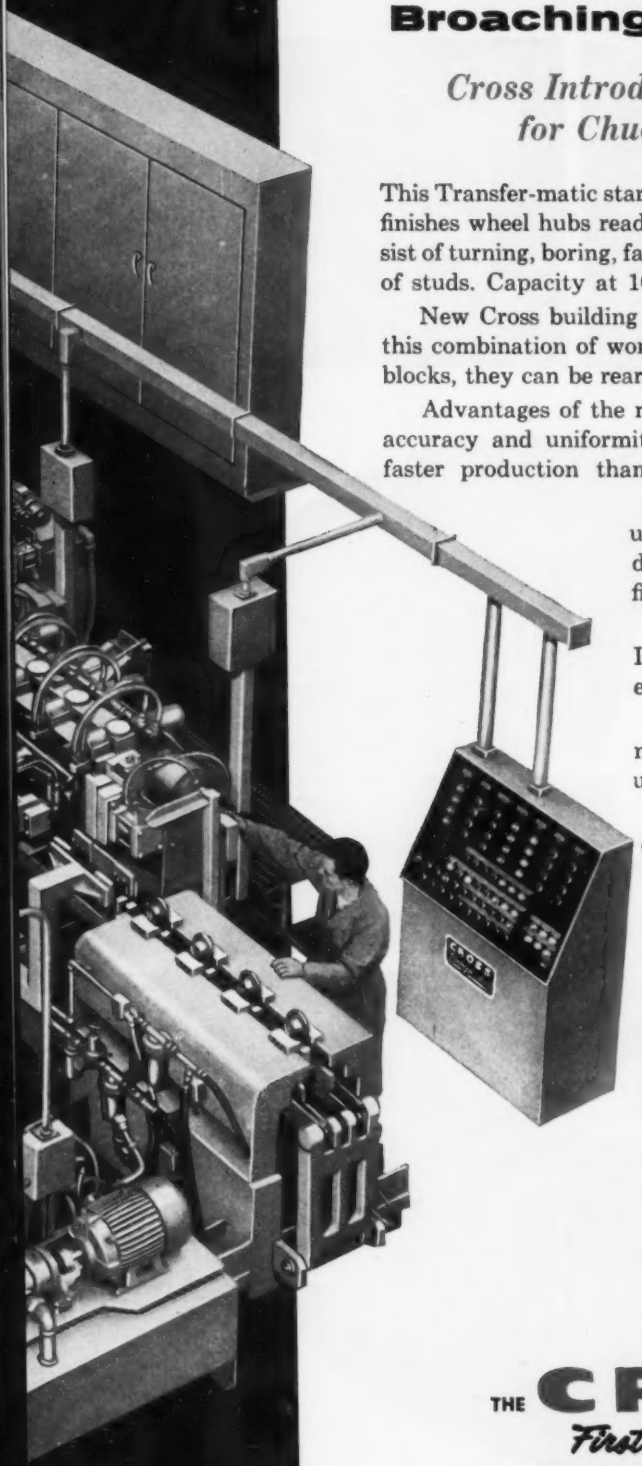
horizontal milling and boring machines / planers / milling planers

Tool slides are rotated to the upward position so tools can be seen, reached and replaced easily.

Another Automation First by Cross

New Transfer-matic Combines Chucking with Drilling, Broaching and Assembly

Cross Introduces Building Blocks for Chucking Operations



This Transfer-matic starts with rough castings and completely finishes wheel hubs ready for final assembly. Operations consist of turning, boring, facing, drilling, broaching, and assembly of studs. Capacity at 100% efficiency is 200 parts per hour.

New Cross building blocks for chucking operations make this combination of work possible. Like other Cross building blocks, they can be rearranged as requirements change.

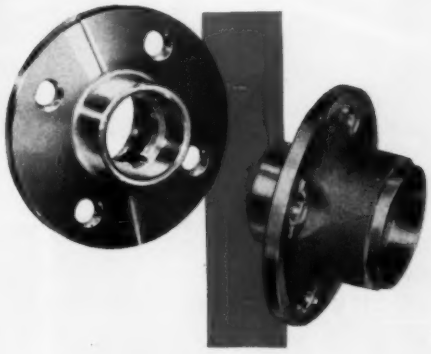
Advantages of the new Transfer-matic include maximum accuracy and uniformity, higher output, less handling, and faster production than conventional methods.

Heavy duty, three jaw chucks are used on the roughing operations but diaphragm types are employed for finishing to avoid clamping distortion.

A work bank between Sections I and II permits independent operation of either one during maintenance.

The new building blocks include a novel slide unit which tilts the tools upward to speed changes.

Cross engineers will gladly discuss details of this Transfer-matic with you.

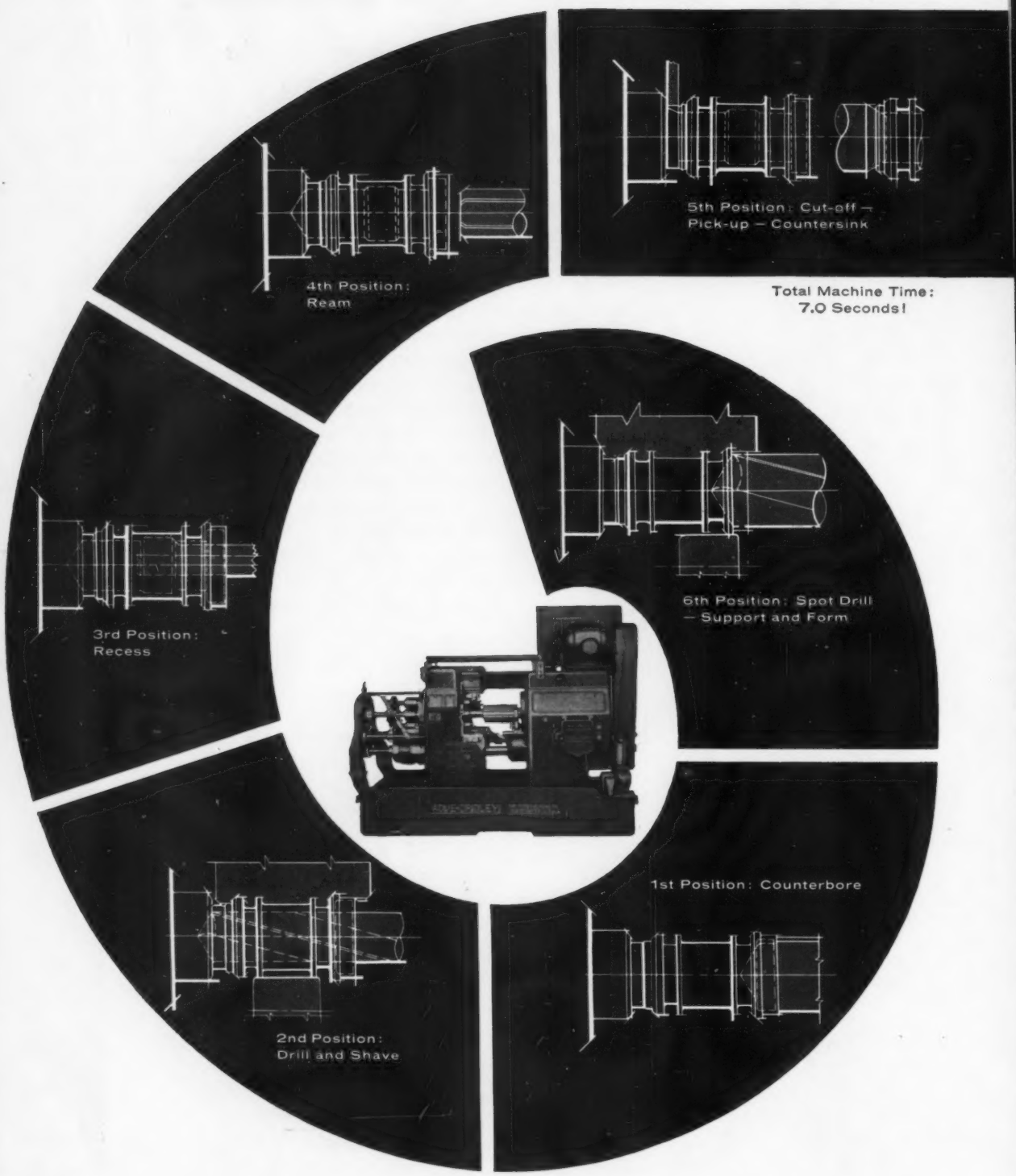


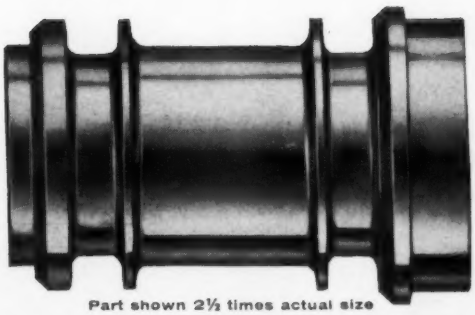
Established 1898

THE **CROSS** CO.

First in Automation

PARK GROVE STATION • DETROIT 5, MICHIGAN


5th Position: Cut-off — Pick-up — Countersink
Total Machine Time: 7.0 Seconds!
4th Position: Ream
6th Position: Spot Drill — Support and Form
3rd Position: Recess
1st Position: Counterbore
2nd Position: Drill and Shave



Part shown 2½ times actual size

"EVEN WE WERE SURPRISED WHEN THE ACME-GRIDLEY DOUBLED OUR PRODUCTION

We'd refigured our set up for bushing blank production and were convinced that the Acme-Gridley would produce greater results than our current automatic machine set up. But, when we *doubled* production and wiped out a 7% reject rate to boot, we were amazed!"

Here at National Acme, we hear a lot of statements like this one made by Ness, Inc., up in Rochester, N. Y. They're one of the country's top product shops and tell us Acme-Gridleys have a lot to do with their success. Just about anybody who has to produce large amounts of an identical precision part will tell you the same thing.

The number of *different* jobs that can be set up on an Acme-Gridley amazes everyone. To give you some idea, we've described some 57 actual jobs in a new 64 page bulletin called "Circumferential Automation at Work". For your free copy, call, write or wire.

National Acme

The National Acme Company
179 E. 131st Street
Cleveland 8, Ohio

Sales Offices: Newark 2, N.J.; Chicago 6, Ill.; Detroit 27, Mich.

The Friden Flexowriter®: Machine Tool's Machine Tool

At the recent Machine Tool Exposition, approximately 80% of the numerically controlled tools on display featured 8-channel punched paper tape input.

The toolmakers have shown this overwhelming preference for punched paper tape for several reasons:

1) the tapes are easy to prepare,
2) the coding is visible,
3) tape can't get out of sequence,
4) tape is durable and unaffected by chance exposure to magnetic fields.

By standardizing on paper tape input for your numerically controlled tools, you get all the benefits listed above, plus one more: It's so much easier (and less expensive) when all of your numerically controlled tools can be programmed on one device. That device? The Friden NC-1 Flexowriter – the machine tool's machine tool.

THIS ,'S PRACTIMATION: Friden is the world leader in tape technology and the practical application of the automation it makes possible. For full information, call your local Friden Systems Representative. Or write: Friden, Inc., San Leandro, California.

© 1961, FRIDEN, INC.

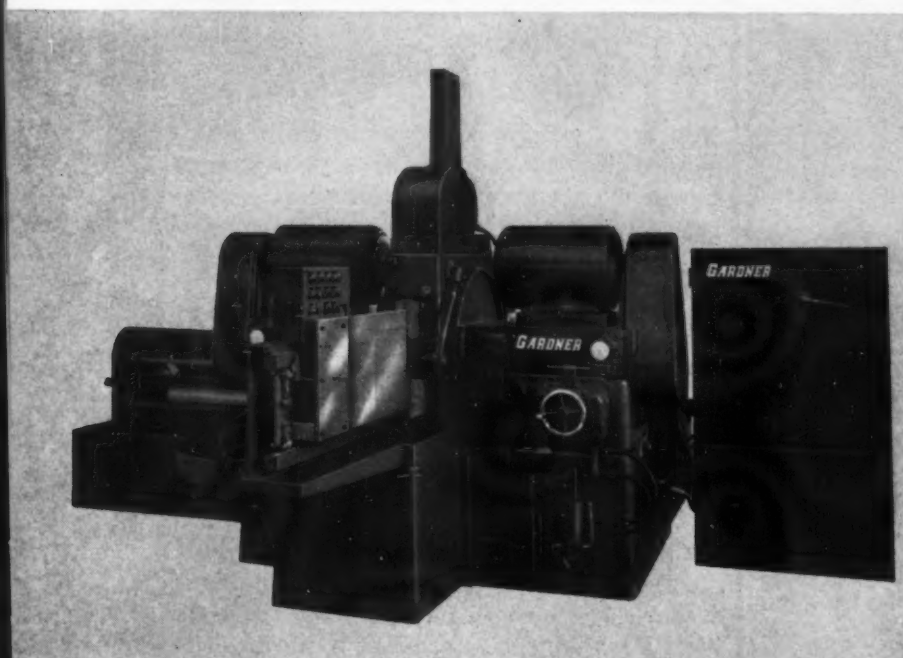
Friden

Sales, Service and Instruction Throughout the U.S. and World

PRODUCTION INCREASED TEN TIMES

One Gardner disc grinder increases production 10 times over old method

- replaces 8 milling machines
- slashes time requirements
- practically eliminates rejects



Gardner precision disc grinder holds close tolerances grinding thin aluminum plate 14" x 18" x 3/16".

Unusual accuracy produces aluminum plates to limits of .003" for flatness and parallelism.

Send Gardner your prints for a practical solution to your production problem.

GARDNER
precision disc grinders
BELOIT, WISCONSIN

An invitation

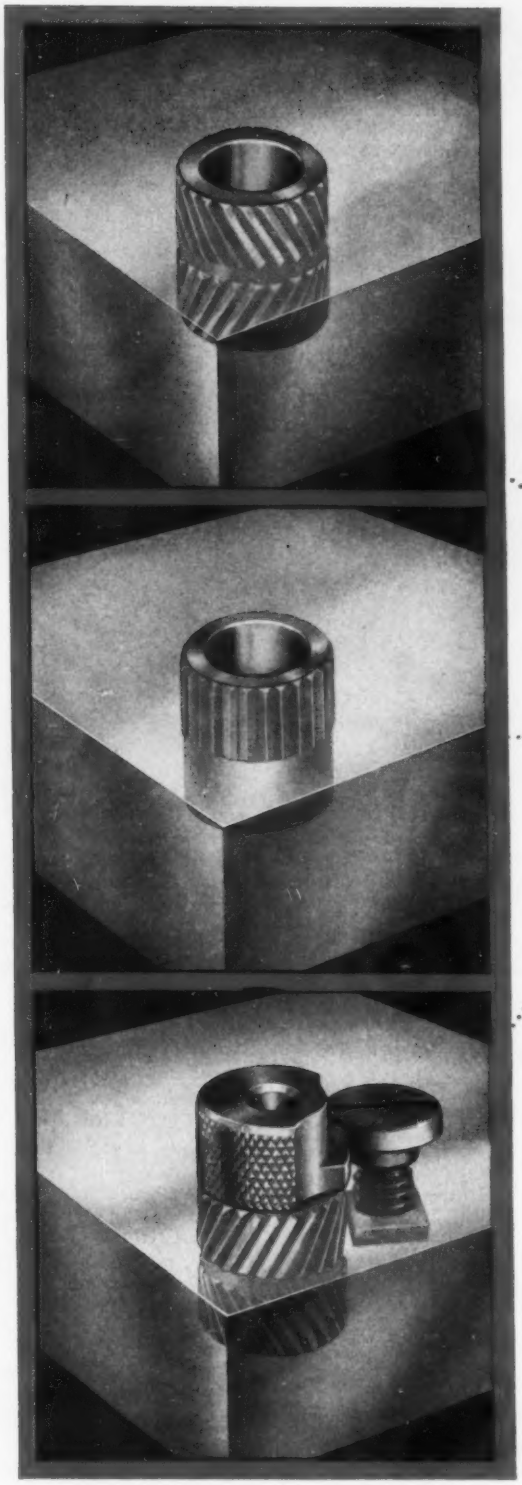
You are cordially invited to join this distinguished group of companies who have entrusted us with the responsibility for solving subcontract problems on components, assemblies and complete, high-precision machines.

Your subcontract headaches will disappear fast in TMW's million square feet of completely integrated manufacturing facilities which include: 1200 *modern* machine tools, a completely mechanized foundry (one of the country's largest), 3000 skilled craftsmen with a corps of industry's top designers and engineers.

TMW's facilities and 65 years' experience in precision (tolerance to 10ths) manufacturing is available to you *now*, on a short or long-term basis. For more details, or for new Facilities File Folder, call or write: Textile Machine Works, Contract Division, Reading, Penna.

TEXTILE MACHINE WORKS

CONTRACT DIVISION • Reading, Pennsylvania



NOW in STOCK for Immediate Delivery...

Ex-Cell-O Drill Jig Bushings for All Plastic Tooling Jobs!

FOR 'POTTING'...

Ex-Cell-O Trans-Lok Bushings have exclusive herringbone knurl and annular groove design for maximum security in potted-type jigs, fixtures and templets. Bushings can't twist or pull out.

FOR PRESSING...

Ex-Cell-O Press-Lok Bushings have straight knurls for greater gripping power when pressed into plastic, wood or other ductile materials.

FOR RENEWABLE BUSHINGS, TOO...

Ex-Cell-O Trans-Lok Liners, with the same deep transverse ridges as Trans-Lok Bushings, permit drilling or reaming using standard fixed-renewable or slip-renewable bushings.

Made of high chrome, high carbon oil-hardening bearing steel, Ex-Cell-O Bushings for plastics have uniform hardness, 62-64 Rockwell C precision ground diameters, and conform to A.S.A. standards and Ex-Cell-O's own high standards for quality.

Send today for catalogs covering Ex-Cell-O's complete line of bushings for plastics and metal or order direct from stocks in Detroit or Downey, Cal.

60-70

EX-CELL-O FOR PRECISION

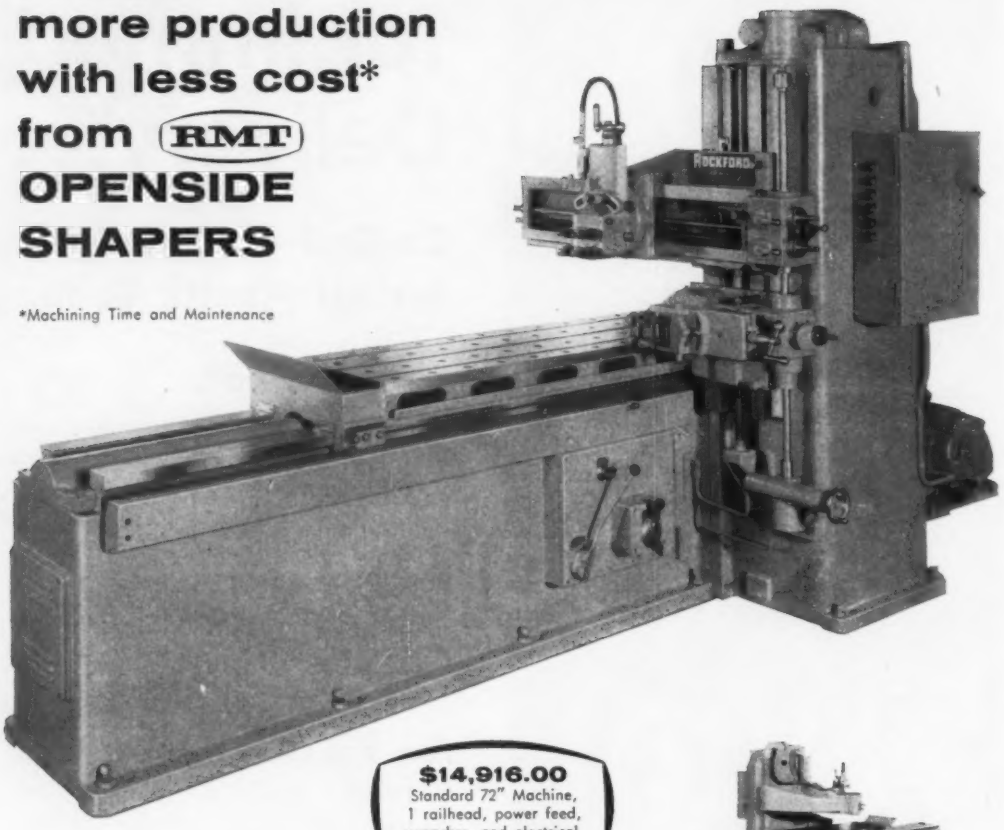
PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • TORQUE ACTUATORS • CONTOUR PROJECTORS • GAGES AND GAGING EQUIPMENT • GRANITE SURFACE PLATES • COMPUTER PRODUCTS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • ATOMIC ENERGY EQUIPMENT • DAIRY AND OTHER PACKAGING EQUIPMENT

Precision Parts Division

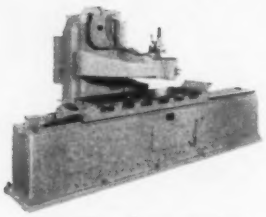
EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

FACTS SHOW- you get more production with less cost* from RMT OPENSIDE SHAPERS

*Machining Time and Maintenance



$14,916.00
Standard 72" Machine, 1 railhead, power feed, wrenches, and electrical.



Rear View shows massive column with rigid railbrace.

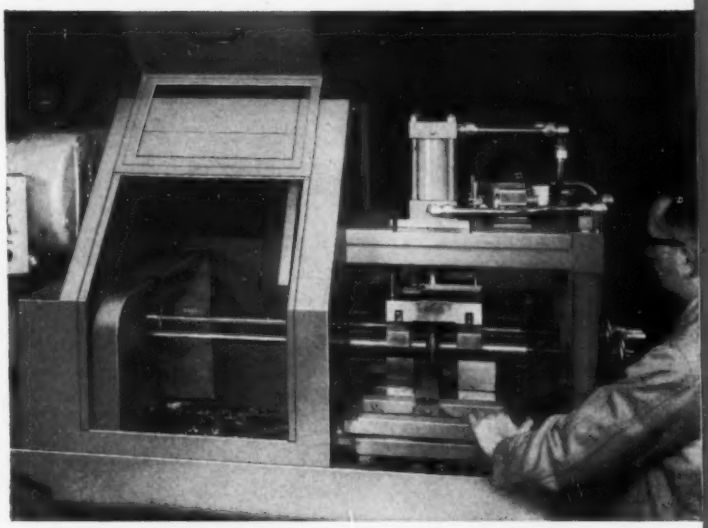
- Infinitely Variable Feeds and Speeds to suit all cutting conditions, instantly selected.
- Fast Table Reversals, no electrical contactors to wear-out.
- Planer Accuracies and Capacities at Shaper Cost.

Check your production requirements and operating efficiency with one of our engineers, and permit him to quote you the cost of owning and operating one of these modern production machines. Then, make any comparisons you desire, and the answer will inevitably reflect the advantages of Rockford Hydraulic design.

ROCKFORD MACHINE TOOL CO., ROCKFORD, ILLINOIS

For more data circle this page number on card at back of book

Deep Holes...Fast and True... with Ex-Cell-O BOR-DRIL



Drilling 11/16" diameter holes the full length of 22½"-long forgings posed a tough problem for production engineers who need the economy of volume output, the time-savings of one-step operations, and the performance of precision equipment. But they found the answer in Bor-Dril, Ex-Cell-O's process for gun-type drilling with standard production boring machines.

Measured in terms of production efficiency, the result is 20 pieces per hour, from an Ex-Cell-O Model 752 Precision Boring Machine set up for Bor-Drilling. Secondary operations are eliminated.

Bor-Dril can be applied easily and economically wherever you have long, small-diameter holes to produce to precision tolerances. See your Ex-Cell-O Representative, or submit your requirements direct to Ex-Cell-O for prompt analysis and cost estimate.

The Bor-Dril process produces in one pass straight, smooth holes through track roller shafts 22½" long and weighing about 75 pounds each. Production is 20 pieces per hour on the two-station machine.

60-30

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Machinery Division

EX-CELL-O CORPORATION

DETROIT 32, MICHIGAN

AT O'KEEFE & MERRITT...

everyone's impressed by the quality of Stampings produced by this Verson 300 ton Eccentric Press

As part of a long range expansion and modernization program, O'Keefe and Merritt Co., Los Angeles appliance manufacturers, have installed this 300 ton Verson Eccentric Press.

Before buying they stated their requirements as follows: The press must improve quality, eliminate excessive handling, provide uniform parts and reduce rejects, and be adaptable to fabricating a wide variety of pieces. That's a big order . . . the Verson Eccentric fills it.

Shown above are officials of the company checking the first burner box bottom for a free standing range formed in the new press. They liked what they saw . . . the press performs two operations, requires one operator, and produces a high quality stamping.

Do you have tough press requirements? You'll find that Verson can meet them. It's easy to put the Verson team to work for you. Just contact your Verson Representative.

250

VERSON ALLSTEEL PRESS CO. / 9309 S. Kenwood Avenue, Chicago 19, Illinois
8300 S. Central Expressway, Dallas, Texas

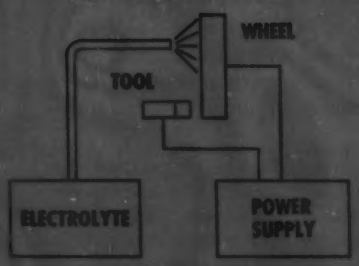
MANUFACTURERS OF MECHANICAL AND HYDRAULIC PRESSES AND PRESS BRAKES
TRANSMAT PRESSES • IMPACT MACHINING PRESSES • TOOLING • DIE CUSHIONS • VERSON-WHEELON HYDRAULIC PRESSES • HYDRAULIC SHEARS

NEW

Reciprocating Electrolytic Tool Grinder

MICRO-FINISHES CARBIDES, CUTS DIAMOND-WHEEL WEAR 80%

59-25



ELECTROCHEMICAL METAL REMOVING "LETS THE ELECTROLYTE DO THE GRINDING"

As conductive, metal-bonded wheel reciprocates across face of tool, inexpensive salt-solution flows between the tool and the wheel, creating electrolytic cell; the tool becomes the anode. Material is removed essentially as in a deplating process—but at much higher speed—leaving burr-free finish.

Because its reciprocating wheel just "wipes away" the carbide particles, Ex-Cell-O's Style 264 Electrolytic Tool Grinder reduces diamond wheel consumption by as much as 80 per cent! With one set-up, tools can be precision-finished to better than 15 micro-inches—free from heat checks, cracks or burns caused by abrasive contact.

The Style 264 grinds the cutting edges of carbides and other super-hard tool materials at one end, grinds chip breakers at the other. Wheel stroke is fully adjustable. Standard equipment includes: Ex-Cell-O Precision Spindle with inbuilt reversible motor, universal chip breaker fixture (shown in circled inset, above), and pressure system for electrolyte.

Write direct, or see your Ex-Cell-O Representative for details on the Style 264, conventional Style 142 Reciprocating Tool Grinder, and others in the complete Ex-Cell-O line.

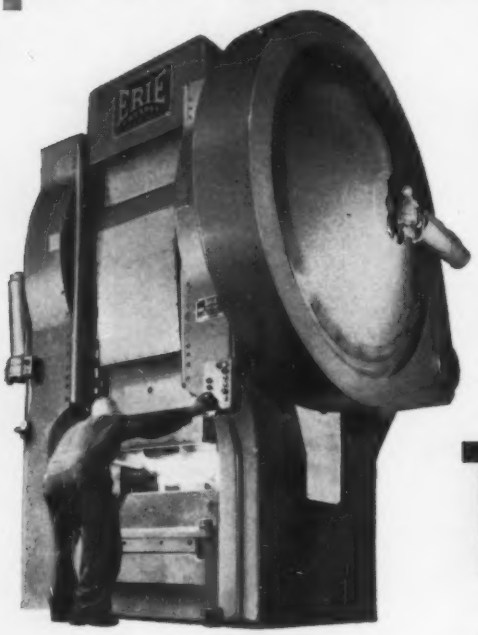
EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

XLO
EX-CELL-O FOR PRECISION
Machinery Division

EX-CELL-O PRECISION PRODUCTS INCLUDE: MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • TORQUE ACTUATORS • THREAD AND GROOVE GAGES • GRANITE SURFACE PLATES • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

WANT TO AUTOMATE YOUR FORGING OPERATION?

You set your production goal . . .



ERIE WILL BUILD THE PRESS

Set your sights on higher output . . . Erie Foundry makes it possible to achieve it, with a high-volume automated forging press. As the first company to automate forging, Erie specializes in custom-designing and building automated presses in capacities up to 8,000 tons.

A single Erie-built automated press, with only one operator-observer, can actually triple your present production rate equalling the output of three regular forging presses and nine production men!

Trimming, too, can be accomplished in a single production cycle. With billet supply and finished part removal conveyorized you can achieve a production volume of, say, 1200 track-link forgings per hour.

To meet your specific needs, Erie Foundry will design a machine for high volume production of such parts as connecting rods, gear blanks, automotive and tractor valves, pinions, track links and wheel hubs.

For the complete story, phone or write Mr. R. E. Sanford, Erie Foundry Company, Erie 1, Pa.

ERIE

ERIE FOUNDRY COMPANY SINCE 1895

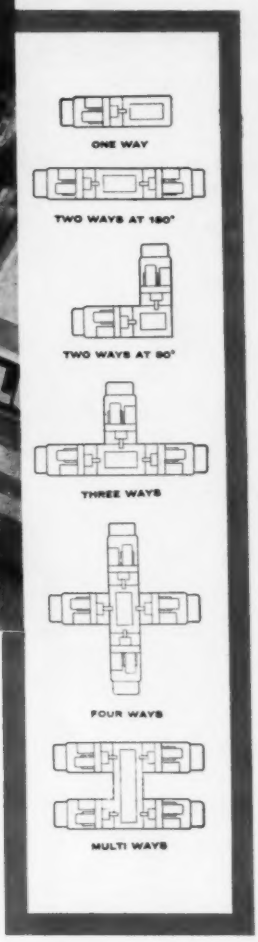
ONE OF THE GREAT NAMES IN FORGING

EF-60-03

Manufacturers of Forging Hammers • Forging Presses • Hydraulic Presses • Trimming Presses

J-8082

TYPICAL
"BUILDING BLOCK"
ARRANGEMENT



4-Way Production Savings with Ex-Cell-O Way Machines

1 LOWER COST Each Ex-Cell-O "Building Block" Way Machine Unit has standard base, table slide and complete, inbuilt hydraulic system. You can specify only the standard spindles or accessories that meet your present needs. **2 INCREASED FLEXIBILITY** One Way-type unit gives you a basic, versatile precision boring machine; as operations become more complex, simply add one or more Way units to a common end section to multiply production or machining functions. **3 MORE VERSATILITY** Ex-Cell-O Way Machines permit precision boring, turning, facing or grooving, chamfering or counterboring—with or without automatic cycles, work indexing or clamping. **4 GREATER CAPACITY** Using simple fixtures, you can rough or finish-machine larger, heavier work than possible on most standard boring machines.

Ask your Ex-Cell-O Representative about savings with Way-type Machines, or write direct for details.

Typical setup shows four units positioned at 90° for simultaneous rough boring, counterboring and trepanning. Beds, tables, center section, hydraulic systems, controls and Ex-Cell-O Precision Spindles are standard components. Units can be rearranged at any time.

60-29

EX-CELL-O FOR PRECISION

MANUFACTURERS OF PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • DRILL JIG BUSHINGS • TORQUE ACTUATORS • CONTOUR PROJECTORS • GAGES AND GAGING EQUIPMENT • GRANITE SURFACE PLATES • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • ATOMIC ENERGY EQUIPMENT • RAILROAD PINS AND BUSHINGS • DAIRY AND OTHER PACKAGING EQUIPMENT

Machinery Division

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

SELECT THE VALVES TO MEET THE NEED!

Select from full lines to operate and control a single OEM product . . . or a plant's entire production line!

Modern manufacturing demands quality . . . and Schrader Valves have it. Complete lines give you almost limitless range in planning air circuitry. The many extras in all Schrader Valves . . . superb engineering, compactness, strength, easy installation . . . make for precision operation. Your Schrader distributor is fully stocked, not only with Valves, but Cylinders and Accessories. He can help you with factory-trained experts and proven ideas.

The complete range of sizes and types of air circuitry products is stocked and cataloged by your Schrader distributor. Consult the yellow pages or write Schrader.

Schrader®
a division of SCOVILL

A. SCHRADER'S SON
Division of Scovill Manufacturing Company, Incorporated
454 Vanderbilt Avenue, Brooklyn 38, N. Y.

QUALITY AIR CONTROL PRODUCTS

For more data circle this page number on card at back of book

Helixform*—a new method for bevel gear production!

The new No. 112 Hypoid Helixform Gear Finisher assures improved quality and increased production on spiral bevel and hypoid non-generated ring gears up to 10½" in diameter, and 2½ DP such as employed in passenger car axles.

The Helixform Cutting Method used on this machine offers these advantages:

Conjugate tooth surfaces, minimized gear development, complete control of tooth bearing, and greater adjustability in final assembly.

We will be glad to send a bulletin giving further details on request. Ask for literature on the No. 112 Hypoid Helixform Gear Finisher and the companion No. 112 Hypoid Gear Rougher. Write for it today.

*Trade-Mark

GLEASON WORKS

1000 UNIVERSITY AVE., ROCHESTER 3, N.Y.

Anaconda takes to the road with ideas for greater values and higher productivity

We're in the market with ideas. Ideas for doing new jobs—like making transistor bases and fluid-cooled conductors. Ideas for doing present jobs better—helping you match the metal to the job more precisely so that you can offer equal or greater value *and* reduce total costs.

These ideas are embodied in Anaconda's line of copper, brass, and bronze mill products, the broadest in the industry—and in the vast pool of experience and technical knowledge of Anaconda men.

To put these ideas to work we've taken to the road with a traveling value-analysis clinic, stopping in industrial centers all over the country. We've a truckload of displays representing our principal products to serve as starting points for discussions of the ideas. We're detaching specialists, technical men, mill men, executives to discuss and explain the ideas with all manufacturers who can attend the clinics.

We're also busy generating new ideas in an aggressive research and development program. And we plan to make available soon small, balanced value-analysis teams to go out in the field and work with individual company organizations—make specific suggestions and recommendations regarding materials, fabricating methods, design, etc.

Anaconda is on the move. If you have problems in which you think a new approach might help—call your Anaconda American Brass representative. Or write: Anaconda American Brass Company, Waterbury 20, Conn.

60105

ANACONDA®

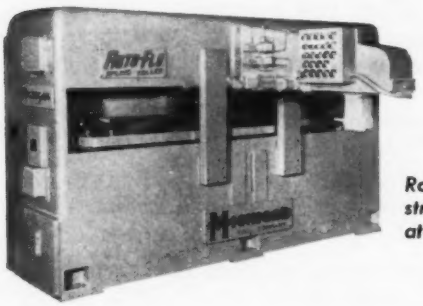
COPPER—BRASS—BRONZE
NICKEL SILVER MILL PRODUCTS

Anaconda American Brass Company

SOLUTIONS TO GEAR PROBLEMS

PROBLEM: TO BOOST TRACTOR AXLE SPLINE STRENGTH WITHOUT HIGHER COST

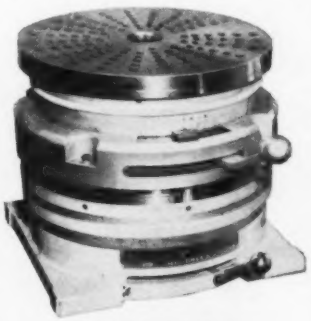
To increase strength of tractor axle shafts produced by a major manufacturer without increasing diameter, Michigan recommended the use of a Roto-Flo machine to cold roll the splines. This resulted in a 60% increase in torque load capacity due to the cold working at the normally weakened section. The "chipless machining" process reduced stress concentrations by 37% and increased production rate three-fold over the slower previous hobbing method. The same machine is used for different sizes of shafts. There were also major savings in tool costs over hobbing.



Roto-Flo gives stronger splines at lower cost

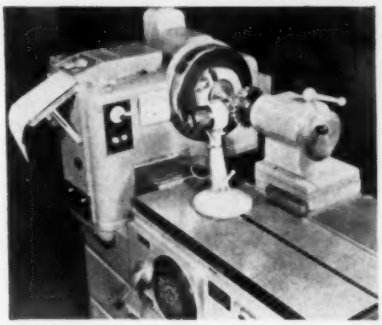
PROBLEM: NEEDED FAST ACCURATE INDEXING IN ¼ DEGREE INCREMENTS

Operations performed on a missile part required extremely accurate indexing in quarter degrees. Precision indexing tables used before required special gage blocks, trigonometry tables and a lot of time. Michigan's answer was a double table version of its Milichex rotary indexing table. This new version, Model M2X-900, provides instant indexing to ¼ degree settings with an accuracy of ¼ second of arc. No gage blocks or trig tables are needed. Operator merely indexes upper and lower tables to proper settings and Milichex automatically locks into exact angular position.



This Milichex indexes in ¼° increments

PROBLEM: 100% CHECK OF GEAR TOLERANCES TO TENTHS IN PRODUCTION

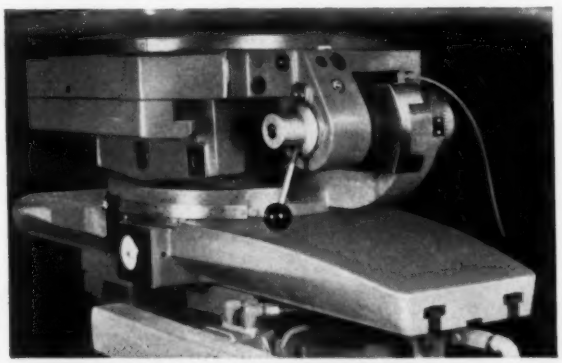


Production lead checking to laboratory tolerances on a 1218-A

A jet engine production bottleneck was the time required to accurately check the lead angle of gears to 0.0003 inch. A Michigan Sine Line 1218-A Lead Checker answered this need. Originally a 'laboratory' type checker, the machine with its precision optical system eliminates the need for "operator feel", records all checks, has the ruggedness for continuous production checking.

PROBLEM: TO SHAVE ANY COMBINATION OF CROWN & TAPER ON SAME MACHINE

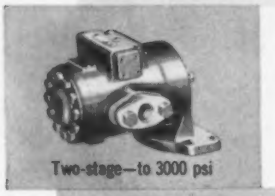
Solved by a compact attachment for the Mark II shaving machine. Setting permanently installed attachment to scale controls amount of taper. An eccentric bushing in the attachment controls taper independently. For uncrowned untapered gears, both are set to 'zero'. Gears can be tapered or crowned with either transverse or modified underpass method. For spur gears, underpass method can also be used.



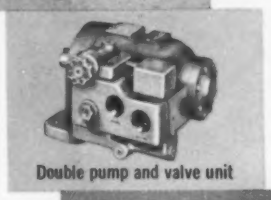
Taper & crown attachment for the Mark II gear shaver

MICHIGAN TOOL COMPANY, 7171 E. McNICHOLS RD., DETROIT 12, MICHIGAN

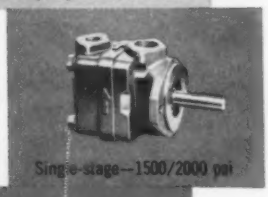
Single stage—to 1000 psi



Two-stage—to 3000 psi



Double pump and valve unit



Single-stage—1500/2000 psi

Single-stage—to 2000 psi

Variable-displacement pressure compensated

For top pump performance on every job!

Only Vickers offers you a complete line of hydraulic pumps tailored to suit your performance, life and price requirements.

* You can select from more than 500 standard models —vane and piston, fixed and variable displacement.
* You can choose models for use with oil or fire-resistant fluids—synthetic, water glycol and water-oil emulsion.
* You may obtain application engineering assistance from *specialists* responsible for a single line of hydraulic products.
* Your replacement units and parts are stocked in regional warehouses . . . unequaled field and shop repair service is provided by factory-trained, experienced technicians.
* You are assured of simplified service and reduced inventory requirements with Vickers replaceable cartridge and repair kits.

For more complete information, write for 70-page Catalog 5001C.

Fixed displacement piston to 5000 psi

VICKERS®

VICKERS INCORPORATED
DIVISION OF SPERRY RAND CORPORATION
Machinery Hydraulics Division
ADMINISTRATIVE and ENGINEERING CENTER
Department 1403 • Detroit 32, Michigan

9139

For more data circle this page number on card at back of book

Production Pointers

from GISHOLT

More cost-cutting IDEAS— to help you

ANCHOR EQUIPMENT REDUCES TIME, TOOLING AND HANDLING

Indexing fixture, cross-feeding turret boost productivity 60%

The problems solved with this setup may be similar to those you face. Anchor Equipment Company, San Francisco, Calif., wanted to reduce tool costs, multiple setups, in-process inventory, and machining time on steel gate valve bodies. Here's how they did it, and improved accuracy as well:

They obtained a Gisholt MASTERLINE® 3L Saddle Type Turret Lathe, with a 42″-swing gapped bed, a 5-position indexing fixture, and a cross-feeding hexagon turret.

The 5-position indexing fixture permits completing all three ends of the 6″, 150-lb. steel gate valve body, shown, in just one chucking (includes two 5° seat areas). A swinging push-button control permits the operator to observe the operation with minimum movement. Fixture jaws change fast to accommodate a variety of work sizes.

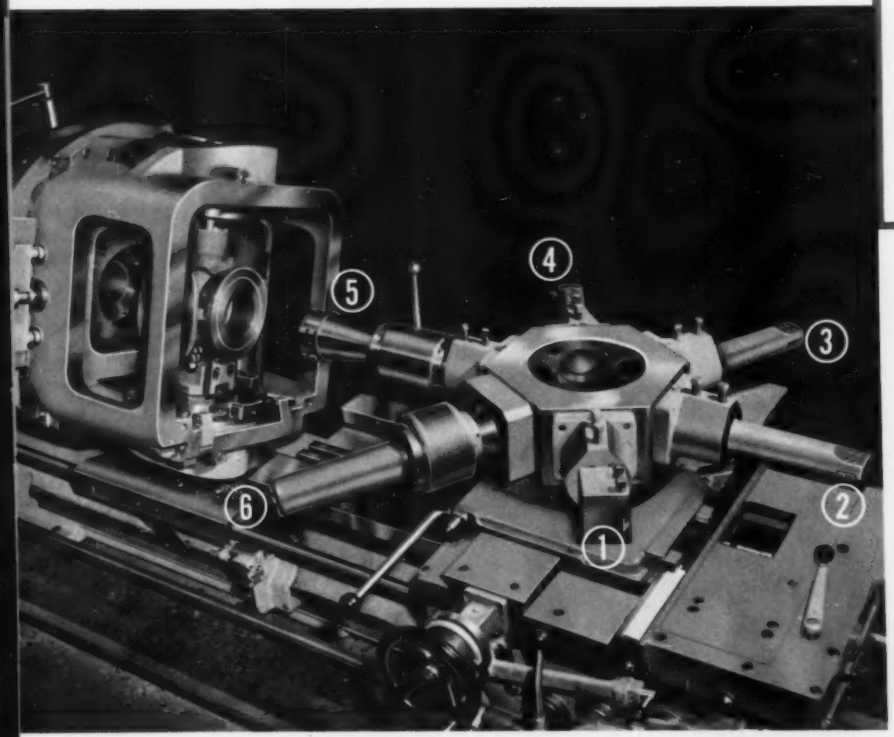
The cross-feeding turret permits use of standard, low-cost boring bars and toolholders. It also permits handling both on- and off-center work (facing, turning, grooving, boring, etc.), eliminating need for a cross slide.

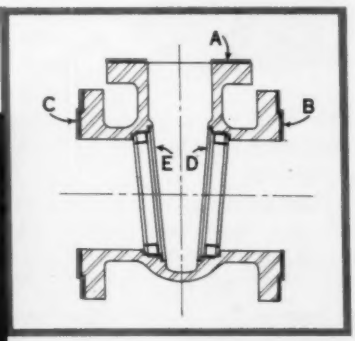
The caption tells how f.t.f. time was reduced 40% on a typical job.

3L cuts time 40%. Cross-feeding hex turret provides versatility, cuts tool costs. Fixture permits completing three ends, two angular seat ring surfaces, and driving of seat rings—all in one chucking.

For information on 3L, circle No. 743 on inquiry card.

Gisholt MASTERLINE 3L tooled for 6″, 150-lb. cast steel gate valve cuts time 40%. Basic setup handles valves 4″, 150-lb., to 10″, 300-lb. Hex 1 tools can serrate raised face of run flanges, and hex 3 tools can finish-face seat rings in place, if required.





Machining sequence on 6″ steel gate valve body: Hex 1—face A, index fixture 90°, face B, index 180°, face C. Offset fixture, index to 5° seat position, rough- and finish-bore and face D from hex 2 and 3. Form relief and chamfer—hex 4. Index to opposite 5° seat position; use reverse feed (standard on Gisholt Saddles); repeat operations on E from hex 2, 3 and 4. Use reverse lead and reverse spindle, thread E from hex 5. Index to opposite 5° position; thread D with forward lead and spindle, and second set of chasers on same bar—hex 5. Drive seat ring—hex 6 (adjustable torque release on driver simplifies operation). Index again, reverse spindle, drive opposite seat ring. One machine boosts total production 60% over previous method using three older machines.

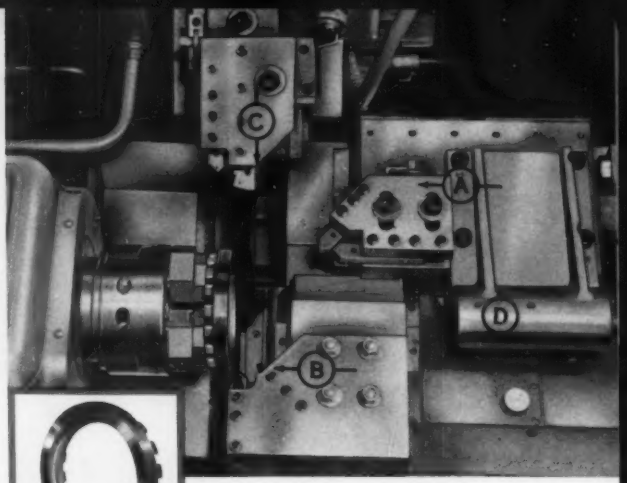
HOW MACK TRUCKS, INC., SAVES TIME BY COMBINING OPERATIONS

Small CRI-DAN B threads work beyond normal range of die heads

If you're looking for ways to head off rising costs, study this setup used by Mack Trucks, Inc., Plainfield, N. J. It shows how you can combine standard machining with single-point threading on the Gisholt CRI-DAN Threading Lathe. In this case, machining and threading times were slashed an average of 60%...work-handling time and floor space were cut in half...and, with all operations completed in one chucking, quality has improved substantially.

The setup, shown at right, handles a variety of over ten cast iron adjustment nuts. Previously, two machines were required: one to machine, the other to mill the thread. To see how CRI-DAN lets others do it for less, study the one-cycle, combination job sequence at right.

Cost-alert management is vitally interested in equipment that can perform like this. Contact your Gisholt Representative or circle No. 744 on inquiry card for complete details.

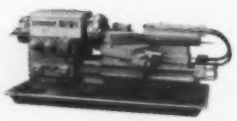


Setup on CRI-DAN B to combine machining and threading on differential bearing adjustment nut, 6½″ diameter, 1½″ wide. Tooling includes an automatic turning slide (A), a standard front threading slide (B), an automatic facing slide (C). The part is located against driving lugs and is chucked in rough bore.

Automatic cycle: Slide (A) tools turn and chamfer O.D.; single-point threading tool on slide (B) produces 12 t.p.i., .054″-deep thread on O.D. in 18 passes, with .003″ tool in-feed per pass. A second "feathering" tool on slide (B) removes a portion of first revolution of thread to eliminate possibility of turning over or breaking off; slide (C) tools face front and chamfer rear O.D. edge. Time: only 106 seconds, f.t.f. A revolving center can be mounted in bracket (D) for parts requiring additional support.

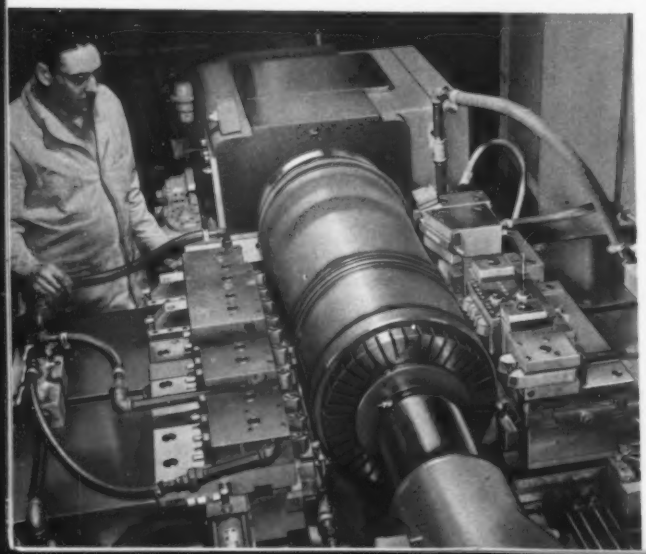
INGERSOLL-RAND BOOSTS PRODUCTIVITY ON LINERS

No. 24 Automatic Lathe machines 20 surfaces with tandem tool slides



Here's how an automatic lathe gives you maximum efficiency in machining multiple surfaces on long parts. First, and most important, is that the machine itself offers the right combination of capacity, horsepower, rigidity, versatility and quick change-over to cut costs.

These were the factors involved in Ingersoll-Rand's decision to purchase a Gisholt MASTERLINE No. 24 Automatic Lathe for cylinder liner machining in their plant at Painted Post, New York. The machine shown, is a second No. 24 recently ordered to meet increased production needs.



Work includes liners from 24¾″ to 43″ in length, 18″ to 21½″ diameter, in lots up to 100 pieces. Up to 20 O.D. surfaces must be rough- and finish-machined.

The work is supported on expanding mandrels at headstock and tailstock. Front and rear carriages are extra wide. Each carriage supports two independent tool slides, linked together to operate as a unit. Separate setups are made for roughing and finishing. The slide tops are accurately marked for fast positioning of blocks with preset indexable tip tools. Size adjustment is provided for each tool. Cam-operated tool blocks, actuated by forward movement of the carriage, are used where tapers are required.

A 100 h.p. motor and the rugged No. 24 headstock permit simultaneous engagement of all 22 tools for the roughing operation on the 20½″-diameter, 43″-long liner shown. These tools turn, taper-turn, blend, face, groove and chamfer. Setup is similar for the finishing operation. Machine rigidity permits holding tolerances of +.005″ to −.000″ on the 43″-long parts.

Twenty-two tools machine 20 surfaces during the automatic roughing cycle. Up to 30 pieces are completed per tool despite heavy stock removal.

No. 24 saves time, improves accuracy over entire work range. It offers capacity and flexibility for maximum savings on large parts.

For information on No. 24, circle No. 745 on inquiry card.

GISHOLT® MACHINE TOOLS SINCE 1897

ASK YOUR GISHOLT REPRESENTATIVE ABOUT FACTORY-REBUILT MACHINES WITH NEW MACHINE GUARANTEE

SUPERFINISH® SAVES TWO OPERATIONS FOR SKF

Eliminates grinding, finishes a face and a diameter at the same time

Superfinish offers a lot more than a fast, automatic cycle that produces a "controlled" surface finish at minimum cost. Other important benefits that will assure top management approval when making your new equipment requests are demonstrated by this setup used by SKF Industries, Inc.

Benefit No. 1—Eliminates and combines operations

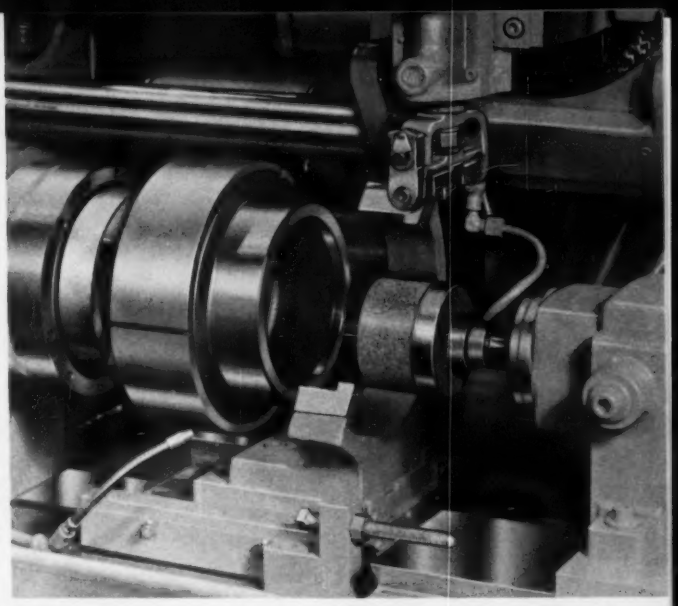
Here a Model 51A Superfinishes two surfaces on cast iron railroad axle caps. These surfaces are first machined, then Superfinished. Grinding is eliminated. The upper stones engage the seal diameter and remove .003″ stock while reducing the surface from 150 to 20 micro-inches RMS. *At the same time*, the cup wheel on the rotary quill Superfinishes the induction-hardened roller thrust face from 150 to 15 micro-inches RMS. A .005″ taper is also created on the thrust face.

Benefit No. 2—Improves surface quality for longer service life

Minute peaks that cause excessive wear or galling are removed. The true bearing area is increased as much as 80%. Some valleys remain to retain lubricant. Load capacity is increased substantially.

Benefit No. 3—Versatility and quick setup

SKF uses one machine to Superfinish both flat and cylindrical surfaces on axle caps, enclosure collars and sleeves in a variety of sizes. Expanding mandrels and face-plate fixtures hold the work. Stone pressure, reciprocation rate, rough and finish spindle speeds, and cycle times are quickly set for each part. Quick-change stone holders further simplify the operation. Longitudinal traverse for long diameters is available.



Axle cap shown in mandrel. Note loading and locating fixture at front center. Stones on overhead quill Superfinish 6.750″-diameter, 1-21/32″-wide seal surface, while the cup wheel, on a rotating quill, advances to Superfinish the roller thrust face. Two operations performed in one chucking.

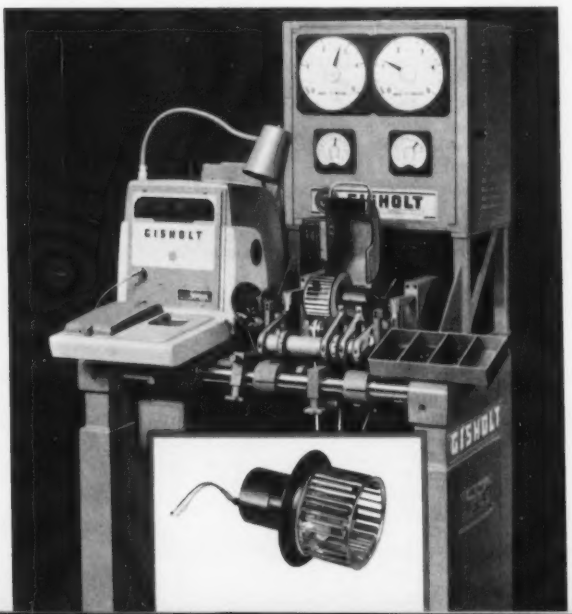
Superfinish cuts previous finishing time in half on part shown, saves in other three major areas. Contact Gisholt for a complete analysis of possible savings on your work.

For information on Superfinishing, circle No. 746 on inquiry card.

HOW YOU CAN SIMPLIFY PRODUCTION BALANCING

NEW ideas reduce work handling, speed production, eliminate chance of error

This setup on a 1S Balancer may point the way to new speed, efficiency and accuracy in your own balancing operations. Featuring several new ideas, this 1S locates, measures, corrects and inspects balance of blower assemblies for automotive air conditioners—all in one fast cycle. A battery of 13 such machines is cutting costs for a well-known eastern automotive components manufacturer.

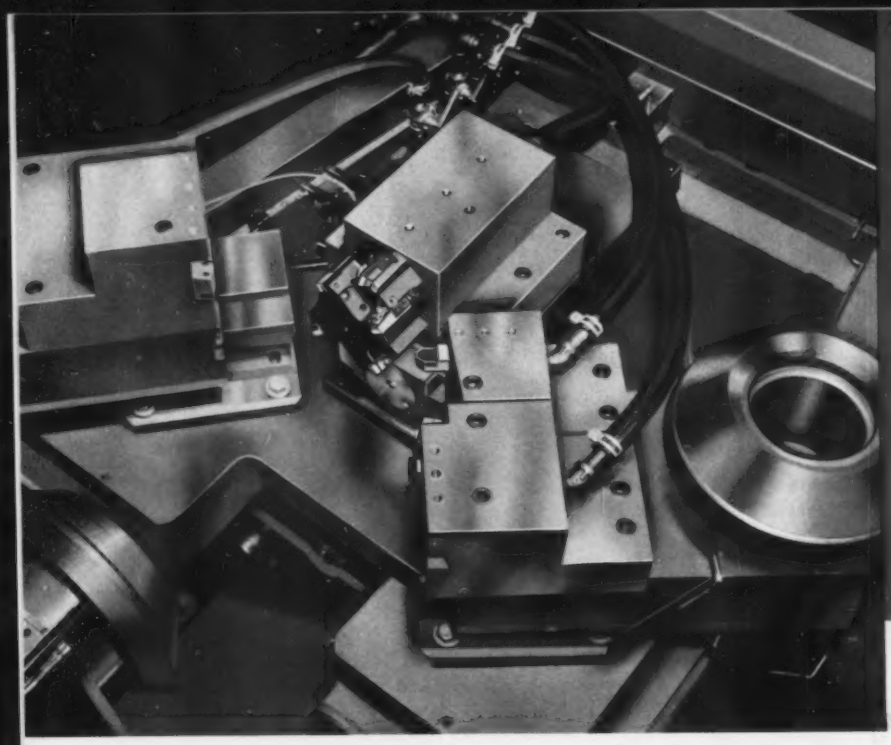


Operating and work-handling time is cut to a minimum by: a direct-loading supporting fixture which works without clamps or half-bearings; a belt drive under the work which eliminates belt-handling; a slip-on scanning cup which eliminates the usual numbered angle reference tape or protractor on the work; a single "left-right" switch which quickly indicates angle and measures amount of unbalance in each plane; separate unbalance location (angle) and amount meters that "hold" readings until corrections are made—one set for each correction plane; automatic starting and stopping of work rotation by raising and lowering of protective shroud. Guesswork is eliminated since meters provide exact indications in terms of correction method used.

Before loading, operator places a scanning cup inside the fan on the hub. Aluminum clips (various weights in tray) are crimped to the vanes at indicated angles in each plane to correct unbalance. The amount meter shows the clip size required to correct within a 1/64 oz. in. tolerance. With this setup on the Gisholt 1S Balancer, one operator locates, measures, corrects unbalance and inspects 74 blower assemblies per hour.

New ideas speed and simplify balancing—eliminate need for operator to remember angle and amount of unbalance in each correction plane.

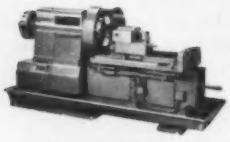
For information on 1S Balancer, circle No. 747 on inquiry card.



Bevel pinion is held on an expanding mandrel. Platen advances tools to work and holds while front slide straddle-faces back angle and face; center slide co-bores; rear slide faces front angle. Time: 3.3 minutes, f.t.f.

THE AUTOMATIC WAY TO HIGHER PROFITS ON YOUR PARTS

Simplimatic® offers "one-pass" completion of second-operation work



Whether you machine bevel gears or not, you can benefit from the ideas used in this setup. It shows how a Gisholt MASTERLINE Simplimatic, a single-spindle automatic lathe, can be tooled to machine a maximum number of surfaces per chucking—providing consistent quality at fixed production rates — leaving the operator free to handle a second machine.

The overhead view of the tooling used in the second operation on steel bevel pinion forgings demonstrates the versatility of this machine. Note the wide platen. Retracted, it provides ample clearance for loading and unloading. The platen is screw-fed and carries the tools to and from the work. It can rapid-traverse, and then hold while the slides operate. It can also rapid-traverse, then feed forward to plunge facing tools to depth; it can bore or position tools in a bore for straddle facing, internal grooving, etc., before standard slide movements begin.

In this setup, front, center and rear independent slides operate simultaneously. All are positioned so that when the platen advances to machining position, they will be close to the work, at the proper angles, and will have minimum tool overhang.

A 40 h.p. motor permits heavy stock removal (angle facing cuts at 250 s.f.m. and .015″ feed, up to ½″ stock removed per side). Machine and tooling rigidity assures accuracy on angles and good surface finish.

For your own work, a tailstock, a separate motor-driven speeder boring bar, a single- or multiple-pass JETracer® slide or an auxiliary slide can be mounted on the platen. A back-facing or back-boring attachment can be operated through the spindle—permitting simultaneous machining of front and back surfaces.

A basic set of tooling can generally be provided to handle a number of work sizes—even parts of quite different configuration—with minimum time for change-over.

Versatile Simplimatic does the work of special machines at standard machine cost. Platen permits unlimited variety of tool slide arrangements for machining maximum number of surfaces per pass.

For information on Simplimatic, circle No. 748 on inquiry card.

Ask about Gisholt "Productivity Team"

Almost any part can be handled at peak efficiency with a "Productivity Team" consisting of an automatic turret lathe and single-spindle automatic. With fast, new setup and change-over advantages, they are now practical for small lots as well as for large production runs.

Gisholt now offers automatic turret lathes in six sizes and four single-spindle automatics. Call your Gisholt Representative. Let him show you how a new Gisholt "Productivity Team" can cut costs on your work.

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MACHINE COMPANY

Madison 10, Wisconsin, U.S.A.

The Gisholt Round Table represents the collective experience of specialists in the machining, surface-finishing and balancing of round and partly round parts. Your problems are welcomed here.

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PRODUCTION JUMPED 466%

when CIMCOOL S2, the world's leading chemical cutting fluid, got on the job in Chicago.

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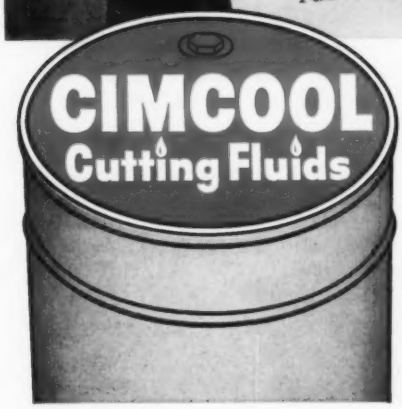
PRODUCTION REPORT
SALES REPORT
2.
and they make electrical components. The trouble they were having was in the high production milling of iron relay cores. They had only been able to turn out 120 cores per hour using straight cutting oil.
When we installed Cimcool S2 at a 1:20 dilution, the SFPM went from 120 to 330, and the feed increased from 2" per min. to 12" per min. As a result they increased production of the relay cores from 120 per hour to 680 per hour. That's a 466% jump!
In addition, they eliminated a de-greasing operation after milling. The machine was cleaner. Chips didn't stick to it. With Cimcool there was no smoke, no rust, no dermatitis and no rancidity
Bill Wolfenson
Chicago Office



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He's Watching a Band Sawing Miracle

This band saw operator at the Bell & Gossett Company plant in Morton Grove, Illinois, is watching "Controlled Accuracy". . . accuracy, being held to within a few thousandths of being perfectly straight, and he can actually *see* the band blade being guided in the saw cut to produce this accuracy! No further machining is required before the pipe is welded into an assembly for a Bell & Gossett Heat Exchanger Unit.

Band sawing accuracy like this is nothing short of miraculous—especially when it can be done on a high production basis, as Bell & Gossett is doing. And when the same tolerances can be held on cut-off pieces from 2" to 18" in diameter, this MARVEL #81 Band Saw Machine can be truly called a precision machine tool.

The secret of this amazing sawing accuracy is in the MARVEL "SURE-LINE" Automatic Accuracy Control—a simple and extremely effective electro-mechanical servo-mechanism that continuously senses and automatically corrects any tendency of a band blade to drift to either side of a desired line of cut. The "SURE-LINE" unit literally "steers" the blade to make a straight cut. This permits the use of heavier feed pressures and, when desirable, higher blade speeds, to do the work faster, without sacrifice of accuracy. Incorporated in the new MARVEL #81 Series High Speed Heavy Duty Hydraulic Band Saws, the "SURE-LINE" permits full utilization of all the advantages of high speed steel band saw blades—while extending their usable blade life as much as 50%.

Before you buy any band saw machine, get complete details on MARVEL #81 Series Single Cut, or Automatic Shuttle Type Bar Feed Production Band Saws—the machines DESIGNED AND BUILT TO REDUCE SAWING COSTS. *Write for catalog today.*

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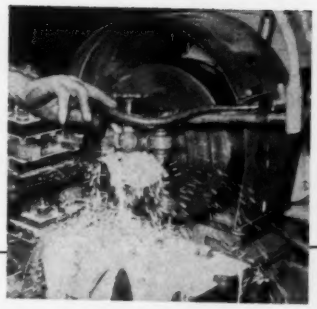

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With Crucible's new Tool Steel Service you cut these costs substantially

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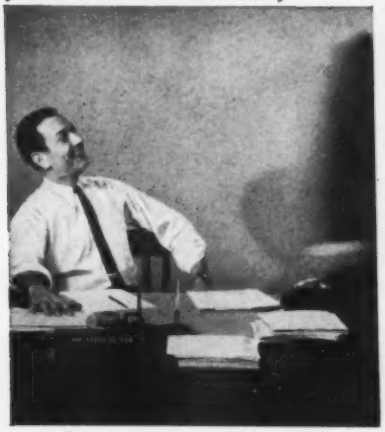
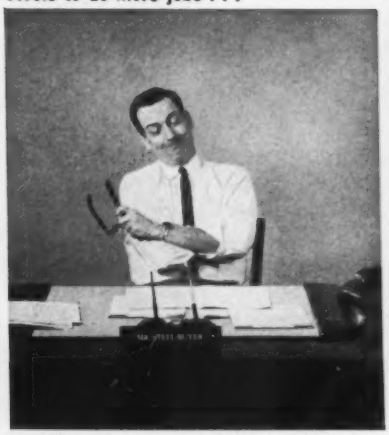


carry fewer pounds in stock (reduce chances of inventory "mix-ups"), and . . .



pay a lower price per pound (by eliminating costs for small quantity "extras").

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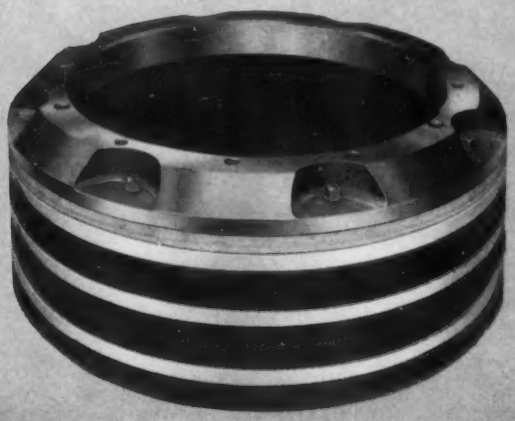
with Gardner tape bound cylinder wheels

continuous, uninterrupted production

eliminates operator hazard

higher strength with tapes an integral part of wheel



Glass fibre tapes grind away as wheel wears . . . eliminate production stoppages required for removal of wire binding.

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DETROIT BROACH

In the Production Picture with Industry's Leaders

LOCATION: Melrose Park Works, Melrose Park, Ill.

INTERNATIONAL HARVESTER COMPANY

... BROACHES FOUR FACES EVERY 24 SECONDS

Removes 225 Pounds of Tough Forged Steel per Hour

The mammoth International TD-24 Crawler Tractor features "live" power and "live" traction on both tracks . . . and these tracks depend on tough forged steel links to deliver both. What's more, it takes smooth, controlled power to machine the links to close tolerances at high production rates . . . and that's exactly what's delivered by the Detroit Broaching Machine that does the job! Here are the facts:

PART: Forged steel track link, Rockwell C32-38.

MACHINE: Detroit Vertical Twin Slide, 25-ton broaching capacity, 100-inch stroke.

OPERATIONS ON EACH SLIDE:

R.H. Station: Broach locating slot, straddle broach parallel sides.

L.H. Station: Broach diagonal keyway; (As one slide is broaching, fixtures on other slide are unloaded and reloaded.)

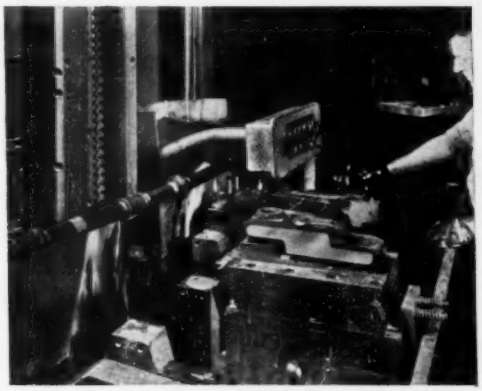
STOCK REMOVED—Approximately 5 cubic inches per piece. Cuts from the parallel sides and keyway are 0.150", balance is removed from the locating slot. Hourly stock removal is 225 pounds.

TOTAL BROACHING TIME PER PIECE: 24 seconds.

This Detroit Broaching Machine is one of several installed by International Harvester . . . and one of *hundreds* "in the production picture with industry's leaders." Let Detroit Broach offer the solution to your production machining problem, including the right machine, the most efficient tooling, and automation to any degree required. Send parts, prints or details of your problem for prompt recommendations.

Write for these Broaching Machine bulletins:

- Vertical Twin Ram
- Vertical Single Ram
- Vertical Pull Down
- Horizontal Internal
- Horizontal Continuous
- Hydraulic Presses



Tooled and fixtured by Detroit Broach specialists, the two-slide machine broaches four surfaces on each workpiece. The fixtures clamp parts hydraulically, are tilted down for broaching by shuttle action of the machine's knee. As one ram is broaching, fixtures at other are unloaded and reloaded.

This rugged, push-shearing action is accomplished smoothly with the "live" power of the International TD-24. A similar action in machining its tough forged steel track links is performed by Detroit Twin Slide Vertical Surface Broaching Machine.

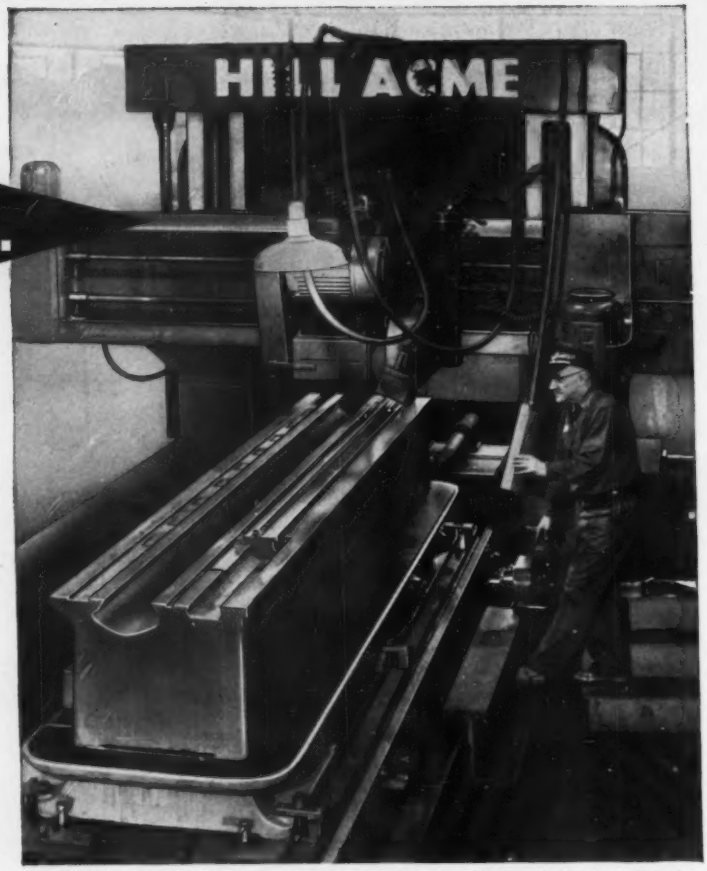
DETROIT BROACH & MACHINE COMPANY

DEPARTMENT A-6 • ROCHESTER, MICHIGAN

Are You Caught...

BETWEEN RISING LABOR COSTS AND CUSTOMER RESISTANCE TO INCREASED PRICES?

A prominent machine tool builder* now saves $1,138.10 in man hours on each spline hobbing machine by using a HILL ACME Surface Grinder to produce flat, parallel ways as compared with their old method of planing and hand scraping: –



Grinding "V" bed ways with a HILL Double Housing Hydraulic Surface Grinder.

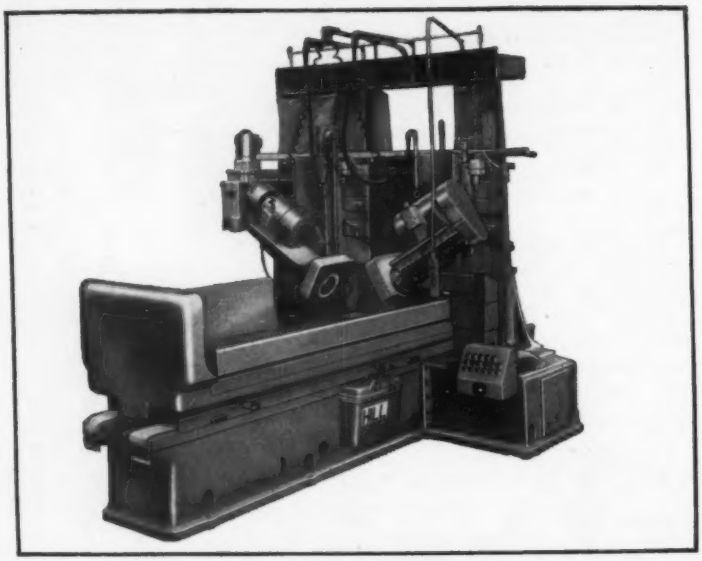
Here is the case history:

ITEM	METHOD	HOURS	RATE	TOTAL LABOR COST	
Bed 8'x72"	Scrape	96.0	2.35	$1,014.72	
	Grind	22.5	2.79	282.37	
				$ 732.35	Savings
Slide	Scrape	12.0	2.35	$ 126.84	
	Grind	.8	2.79	10.04	
				$ 116.80	Savings
Carriage	Scrape	25.0	2.35	$ 264.25	
	Grind	6.0	2.79	75.30	
				$ 188.95	Savings
Total man-hour Savings				$1,138.10	

The manufacturer reports these additional advantages:

1. A consistency of way accuracy assured.
2. Permits the use of integral hardened ways.
3. Gives a uniform oil film between way surfaces.
4. Improves delivery schedules.
5. A very favorable customer acceptance.

HILL ACME Heavy Duty Hydraulic Surface Grinders are adaptable to a wide variety of stock sizes having flat surfaces. Table widths are 24" to 60". Table lengths vary from 7 to 30 feet. Built in both horizontal spindle and vertical spindle design.



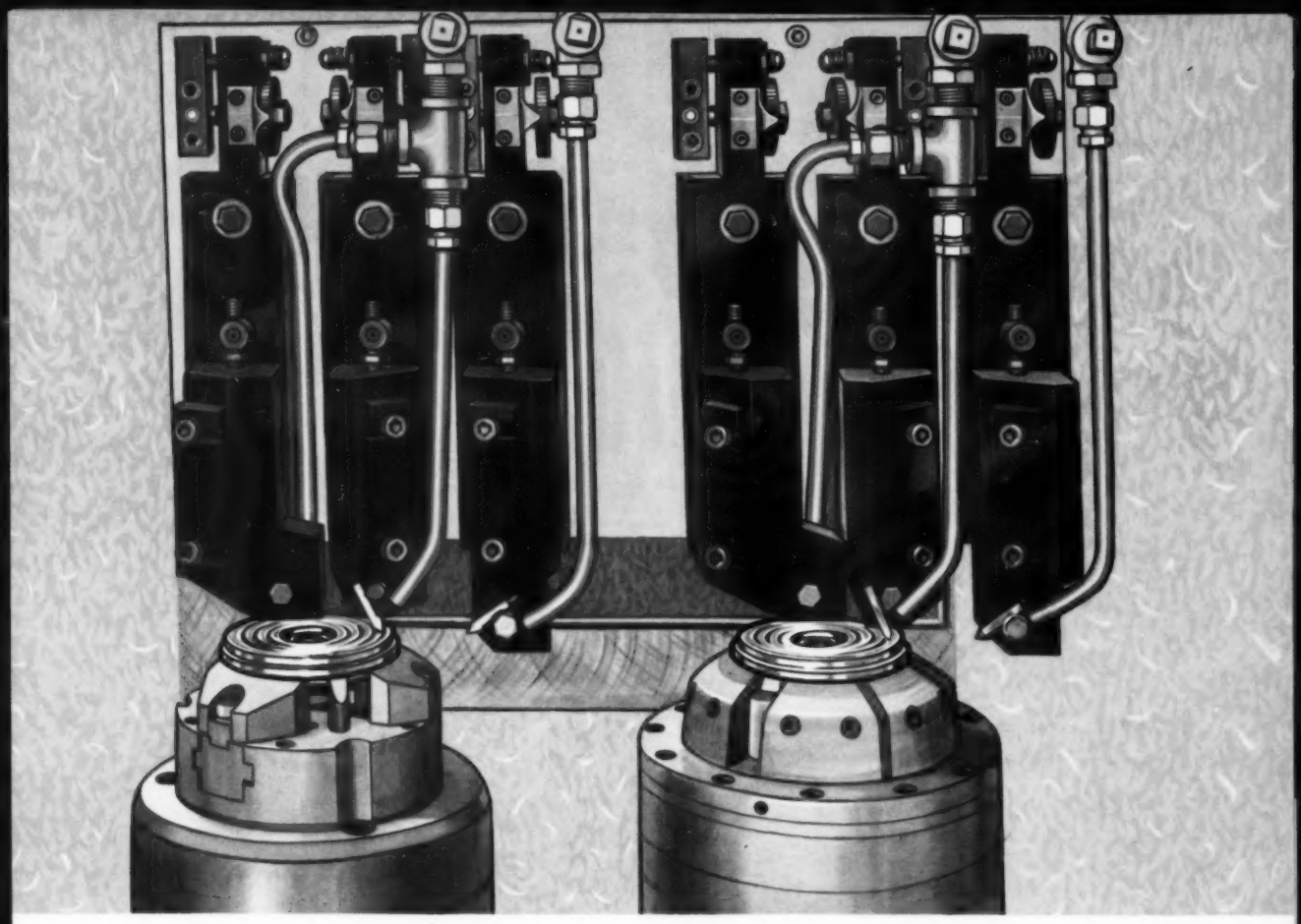
*Builders Name on request

THE HILL ACME COMPANY

1201 WEST 65th STREET
CLEVELAND 2, OHIO

Manufacturers of: Grinding and Polishing Machines • Hydraulic Surface Grinders • Rotary Scrap Shears • "ACME" Forging • Tapping Machines • "CANTON" Alligator Shears • Bar-Billet Shears • "CLEVELAND" Knives & Shear Blades

We now manufacture, distribute & service the entire line of KLING metal working tools.



New Britain's new concept for contour turning and boring

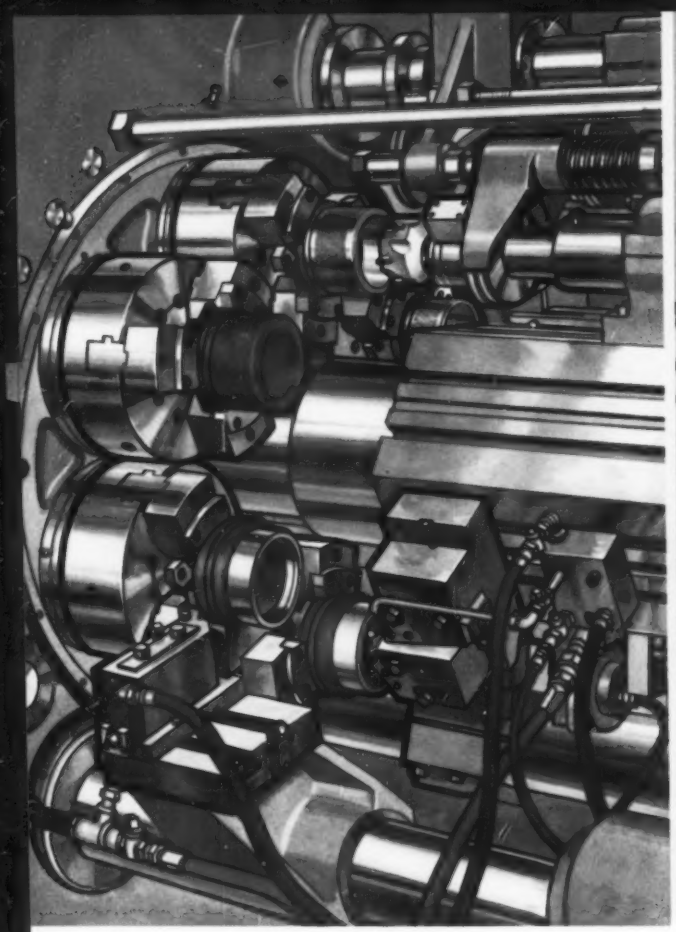
Beyond a certain point, continued refinement of existing designs in machine tools ceases to make an appreciable contribution to performance. Thus in designing our New Series of Vertical Precision Boring Machines, we have incorporated several completely new design concepts to provide improved performance and greatly increase over-all usefulness.

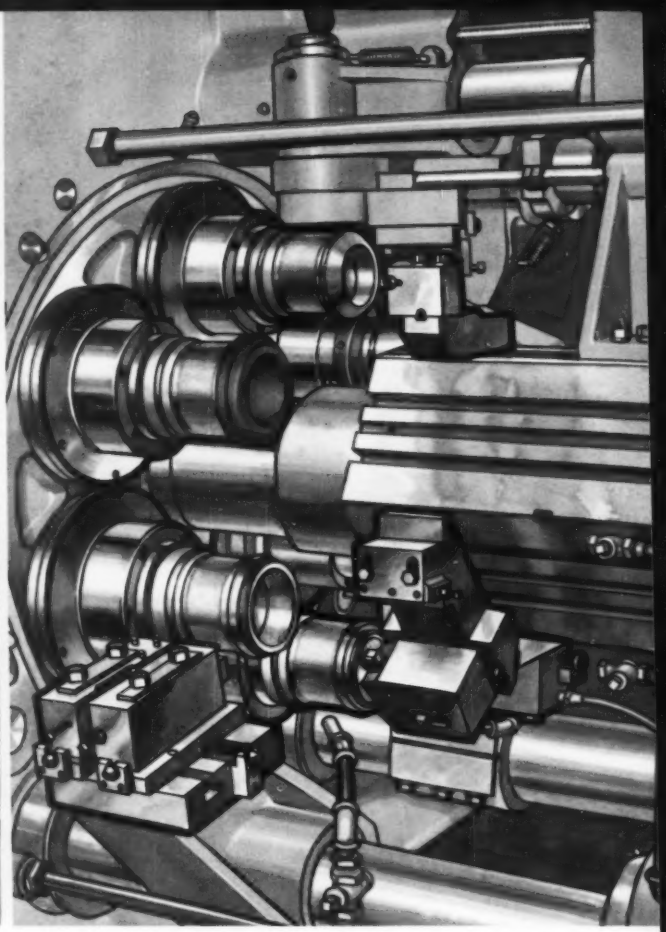
For the first time machines of this type can be used as building block units. Their clean-sided design permits any number of self-contained machines, each with one or more spindles, to be arranged side by side and operated as a single unit. They also may be operated with equal efficiency as individual machines. Parts can be inverted on adjacent machines or on adjacent spindles of the same machine.

In order to take the fullest advantage of the precision inherent in cam control, long linkages between cams and slides have been eliminated. A pair of cams is mounted on a common shaft which is carried *within the vertical slide*. Since all slide actuating forces are contained in the vertical slide, both cams are directly adjacent to the slides they control and no outside forces are imposed on the slide ways. The result is maximum rigidity for heavy cuts coupled with extreme accuracy for close tolerance work.

This unique and eminently workable approach to contour turning and boring results in the highest order of accuracy on even the most complex pieces. Your New Britain Representative can give you details on the nine different models available in this series. For catalog material, write The New Britain Machine Company, New Britain-Gridley Machine Division, New Britain, Conn.

THE NEW BRITAIN MACHINE COMPANY
New Britain-Gridley Machine Division - New Britain, Connecticut





New Britain . . . still the best Chucker you can buy

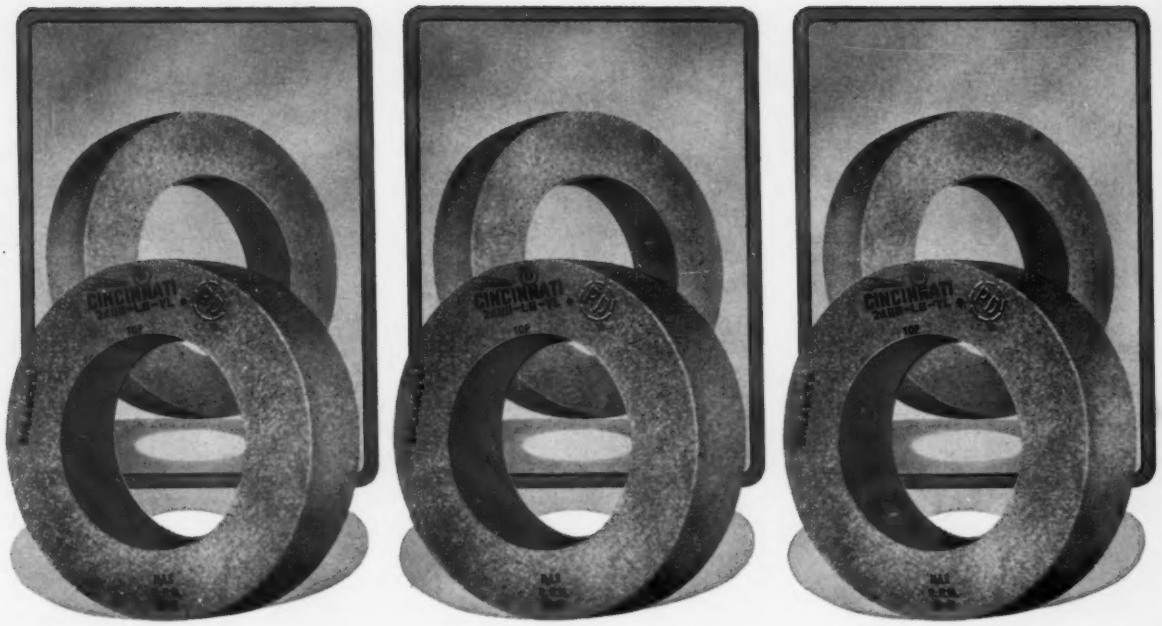
We're not unhappy about the fact that for years, in many plants, the name New Britain has been synonymous with chuckers. New Britain Chuckers have turned out literally millions of pieces of work for practically every major industry in the world. This is less important to the prospective buyer of one of these machines, however, than the capabilities of these machines today. How do they stack up against other chuckers or even other types of machines capable of doing similar work? Pretty well, we think.

New Britain's open-end design still can't be beat for unlimited accessibility to the tooling area. This same wide-open feature makes it doubly more practical to adapt these machines to automatic loading and unloading.

The unusual combination of longitudinal and transverse forming motions is another unbeatable New Britain feature. The massive forming arms on New Britain Chuckers allow heavier cuts and cuts of much greater complexity. This ability to do more work can eliminate the need for second operation machines in many instances. For really complex work, two chuckers set up side by side, as shown here, each doing one side of the piece, can smooth the way for high production. Less complicated work can be set up to perform both sides of the same piece on a single machine.

These massive machines provide the tooling combinations, spindle speeds and power to perform the widest possible variety of work. Their basic design will stay new for years to come, continuing to provide profitable operation. You may know New Britain Chuckers, but you may not be fully aware of the improved series presently being offered. Why not call your New Britain Representative or contact us at The New Britain Machine Company, New Britain-Gridley Machine Division, New Britain, Connecticut.

THE NEW BRITAIN MACHINE COMPANY
New Britain-Gridley Machine Division · New Britain, Connecticut



POSITIVE DUPLICATION—EVERY TIME!

Just as you see these CINCINNATI Centerless Grinding Wheels duplicated with exact fidelity in these mirrors, you can be absolutely sure of Positive Duplication with *all* CINCINNATI (PD)° GRINDING WHEELS.

THREE DOZEN GOOD REASONS

Cincinnati is able to supply you with wheels of uniform excellence, because of its unique (PD) manufacturing process. This involves 36 separate and unvarying quality controls right from grain mix to final inspection.

For example, the six steps to grain uniformity are these: Grain size verified with screens . . . Grain cleanliness . . . Freedom of foreign matter . . . Color . . . Magnetic content . . . and Bulk density must all meet rigid standards.

RESULT: DEPENDABLE PERFORMANCE

You can *depend* on (PD) WHEELS because each reorder wheel gives you exactly the same good job as the original.

Using (PD) WHEELS you will find production going up, and costs going down . . . *to stay!* This is the promise—and the *performance*—of Positive Duplication.

CALL FOR CINCINNATI WHEELS TODAY

Solve your grinding problems with the help of specialists trained by the Cincinnati Milling Machine Company. Their wide experience in job set-ups and grinding operations is at your service. Just call your CINCINNATI (PD) GRINDING WHEELS Distributor or contact Cincinnati Milling Products Division, Cincinnati 9, Ohio.

(PD) POSITIVE DUPLICATION

CINCINNATI°
GRINDING WHEELS

°Trade Mark Reg. U.S. Pat. Off.

A PRODUCTION-PROVED PRODUCT OF THE CINCINNATI MILLING MACHINE CO.

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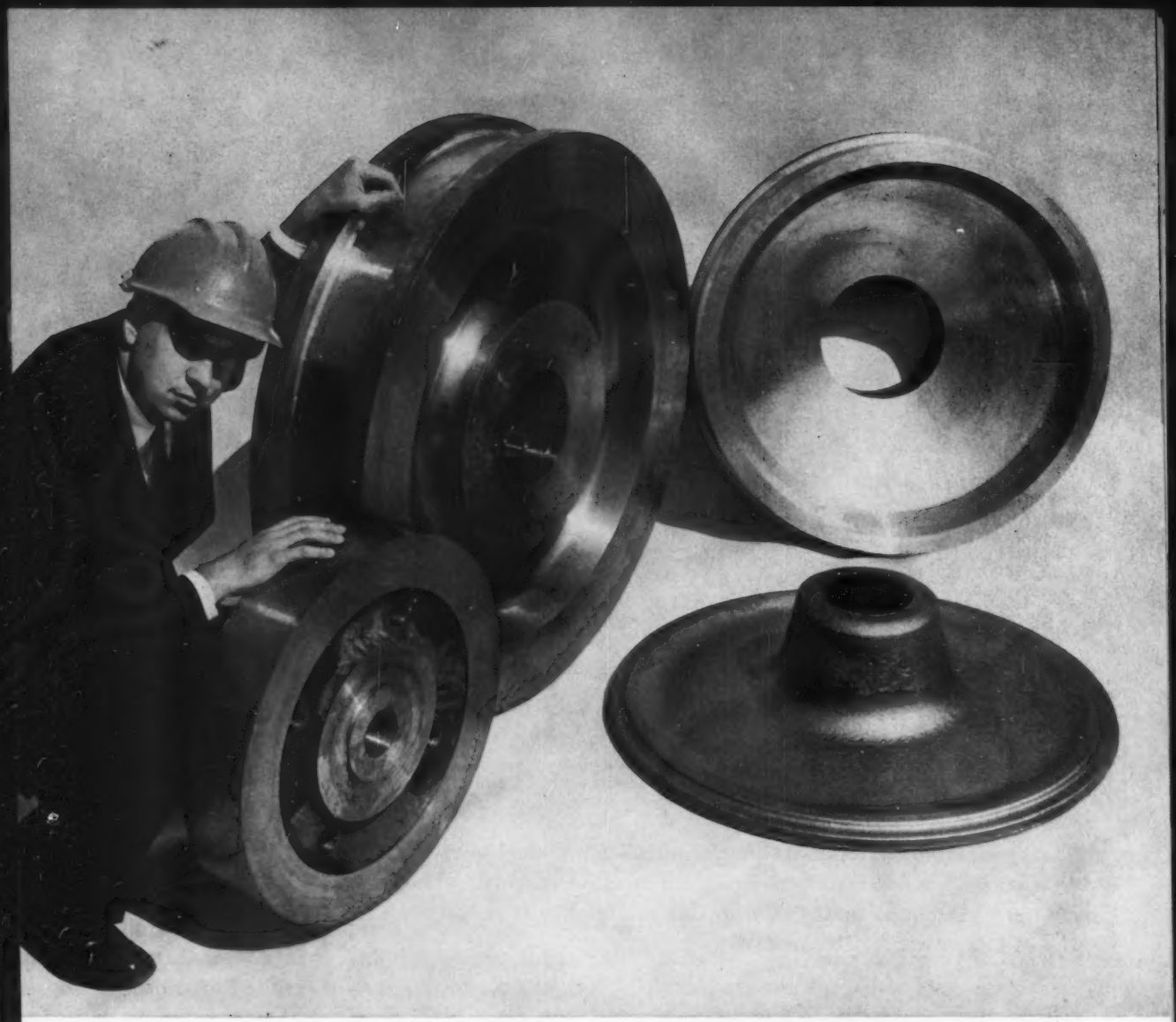

Bethlehem circular forgings are available in carbon, alloy, and stainless steels, and some heat-resistant grades. 10 to 48-in. OD. 100 to 2,000 lb. As-rolled or rough-machined to specifications.

Which cost less, castings or circular forgings?

In initial cost, a Bethlehem circular-forged blank is competitive with a cast blank.

But that's where the competition ends.

Due to the hot working of the metal (our unique Slick Mill forges and rolls a circular product in one operation in one minute), forgings have better physical properties, greater strength than castings.

HIGHER CUTTING SPEEDS—The uniform quality of Bethlehem circular forgings allows you to use higher cutting speeds. Machining time—both in roughing, and in hobbing teeth—is cut; tool life is increased. And there's no chance of sand damaging valuable hobbing tools.

LESS METAL—You'll find, in many cases, weight can be reduced. The greater strength of a *forged* circular product permits thinner rim sections without sacrificing strength.

Our sales engineers will be happy to give you the whole story on Bethlehem circular forgings—competitive initial cost, sure machining savings, possible weight savings, a better-quality product all around.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Export Sales: Bethlehem Steel Export Corporation

Steel *for Strength . . . Economy . . . Versatility*

BETHLEHEM STEEL

BETHLEHEM STEEL

BEST TIP OF ALL!

INDUSTRIAL DISTRIBUTORS · SERVING INDUSTRY ECONOMICALLY · THE RIGHT HAND OF PRODUCTION

Ask your distributor for

Chicago-Latrobe DRILLS

CHICAGO-LATROBE PRODUCES A COMPLETE LINE OF DRILLS, REAMERS, END MILLS, COUNTERSINKS, COUNTERBORES, CARBIDE TIPPED TOOLS, GUN DRILLS, AND THE EXCLUSIVE C-L "LO-TORK" CHIP BREAKER DRILLS. FOR EXPERT ADVICE AND FINEST SERVICE CALL YOUR CHICAGO-LATROBE DISTRIBUTOR.

CHICAGO-LATROBE

428 WEST ONTARIO STREET • CHICAGO 10, ILLINOIS

Clip and File

DRILLING TIPS YOU CAN USE

Select the Correct Helix

The spiral flutes of a twist drill perform three functions. They bring the chips out of the hole; provides the proper rake angle at the cutting lip; permit coolants to reach the point of the drill. These actions are vital. All are affected by the helix (the angle of spiral) of the flutes. Be certain that the helix you choose is the correct one for the material being drilled.

Regular Helix

This is the familiar style and the best helix for most general purpose shop work in steel, forgings, castings, and other ferrous materials. Where extra rigidity is required—as in portable drilling—select a regular helix drill with heavy duty construction.

Fast Helix

In general the fast helix is selected for drilling materials of low tensile strength like aluminum, magnesium, copper, and thermoplastics. These materials produce a large volume of chips and the low angle of incline of the flutes is specially suitable for their removal. Where chip removal is slowing drilling, the fast helix may solve the problem.

Slow Helix

This drill is generally used for materials that break up into very small or powdery chips . . . as occurs in drilling brass; hard rubber; thermo-setting plastics such as bakelite; fibre and plastic laminates. These drills are of light construction with wide flutes and are not usually suitable for heavy duty work.

USE CHICAGO-LATROBE CATALOG NUMBER 60

for the most complete listings of drills of all types—plus valuable advice on their use. INCLUDES PRICES.

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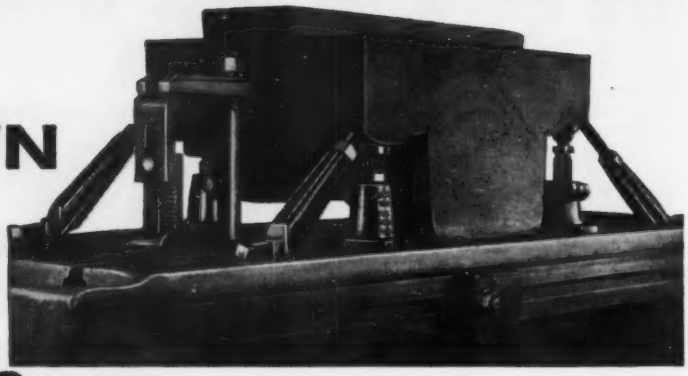
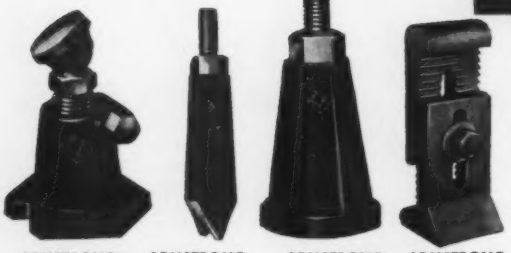
ARMSTRONG

SET-UP *and* HOLD-DOWN TOOLS





ARMSTRONG PLANER JACK | ARMSTRONG BRACING JACK | ARMSTRONG VERTICAL JACK | ARMSTRONG ADJUSTABLE STEP BLOCK

ARMSTRONG "T" SLOT BOLT

ARMSTRONG "T" SLOT NUTS

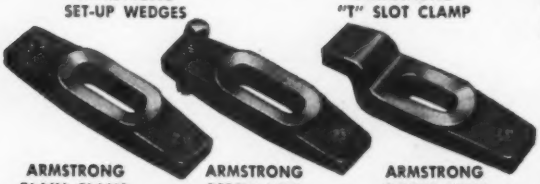
ARMSTRONG NUTS

ARMSTRONG WASHERS

ARMSTRONG UNIVERSAL ADJUSTABLE CLAMP

ARMSTRONG SET-UP WEDGES

ARMSTRONG "T" SLOT CLAMP



ARMSTRONG PLAIN CLAMP | ARMSTRONG SCREW HEEL CLAMP | ARMSTRONG GOOSE NECK CLAMP

ARMSTRONG DOUBLE FINGER CLAMP | ARMSTRONG FINGER CLAMP | ARMSTRONG "U" CLAMP

Whatever its shape, a work piece can be quickly, easily and safely set up on any T-slotted table with ARMSTRONG Set-up Tools. Comprising a complete "system" of supporting and holding devices in all essential sizes, ARMSTRONG Set-up Tools usually pay for themselves on the first job and continue to lower costs for years to come.

Save Time: Keep costly machines and high priced men producing—save time otherwise lost while operators rummage in the scrap box for materials with which to devise makeshift set-up methods.

Prevent Breakage and Spoilage—correctly designed, machined from special steels or drop forged and heat treated, they are extremely stiff, strong and reliable.

Increase Accuracy—hold work rigidly and support it fully regardless of shape.

Prevent Accidents—end risk of set-up failure with resulting tool breakage, damage or personal injury.

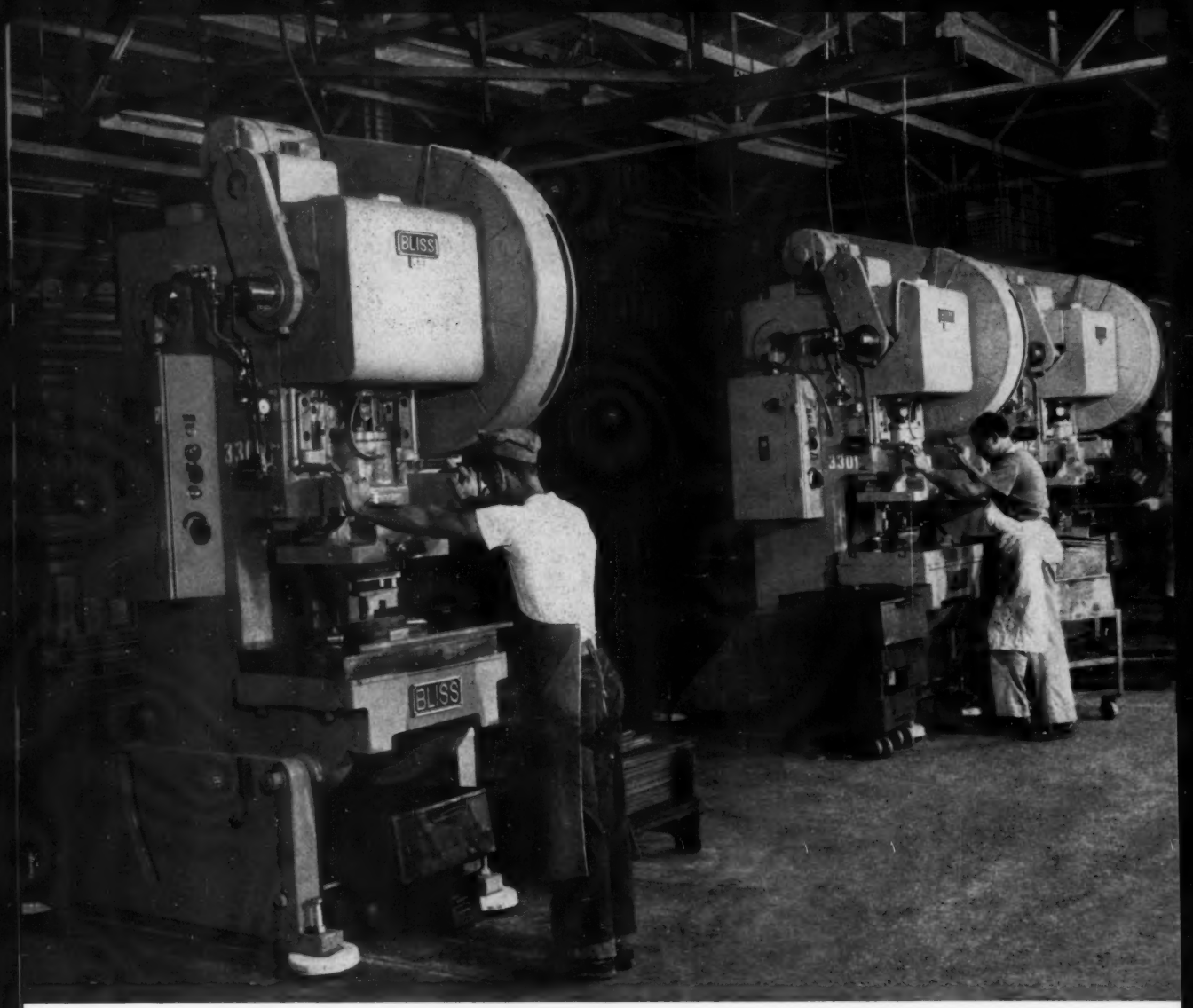
Increase Profits—by reducing down time, increasing man hour output, assuring accuracy, ARMSTRONG Set-up and Hold-down Tools cut costs and build profits. They are part of every properly equipped tool room and shop.

Your Local Armstrong Industrial Distributor carries a good stock of Set-up and Hold-down Tools. He offers you quick, efficient service on these, as well as other, quality ARMSTRONG Tools.

INDUSTRIAL DISTRIBUTORS SERVING INDUSTRY ECONOMICALLY THE RIGHT HAND OF PRODUCTION

ARMSTRONG BROS. TOOL CO.

5213 W. ARMSTRONG AVE. • CHICAGO 46, ILL.



New Bliss inclinables take front seat at American Seating

Shown here and on the front cover are new Bliss C-60 inclinable presses recently installed at American Seating Company, Grand Rapids, Mich. All four presses get day-in, day-out use in a variety of operations . . . they blank, draw, pierce, perforate, punch, trim, form and notch many types and sizes of sheet metal parts that American Seating, world's largest producer of fine institutional furniture, uses in its lines of chairs, desks and other furniture. The new "C" inclinables, with their extremely rugged frames, large bed area and long stroke adjustment, are well-suited for this general-purpose service, with its frequent die changes and strenuous single-tripping. All presses are non-geared and equipped with the Bliss CK crankshaft-mounted air-friction clutch and brake.

If you would like details of Bliss' new "C" inclinables, we will be glad to send you a free copy of our Bulletin 2F. Illustrated in color, it is yours for the asking. Or, if you prefer, our local representative will be happy to give you complete information.

BLISS
SINCE 1857

BLISS is more than a name—it's a guarantee

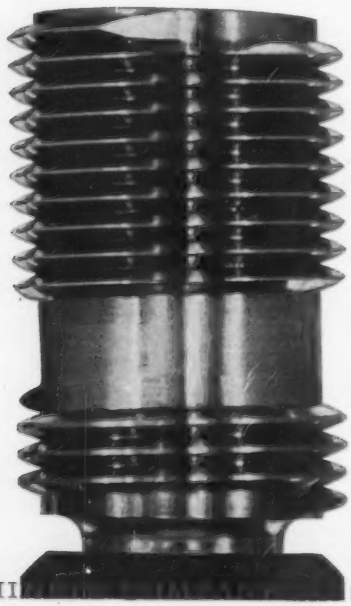
E. W. BLISS COMPANY · Hastings, Michigan

Foreign Subsidiaries: E. W. Bliss (Canada) Ltd., E. W. Bliss (England) Ltd.
E. W. Bliss Co. (Paris) France, E. W. Bliss-Henschel G.M.B.H., Dusseldorf, West Germany

PRESSES · ROLLING MILLS · ROLLS · DIE SETS · CONTAINER MACHINERY · CONTRACT MFG. · PUBLIC SAFETY

You're Not Dependent
On The Human
Yardstick...

With Pipe Machinery HILO Thread Setting Plug Gages

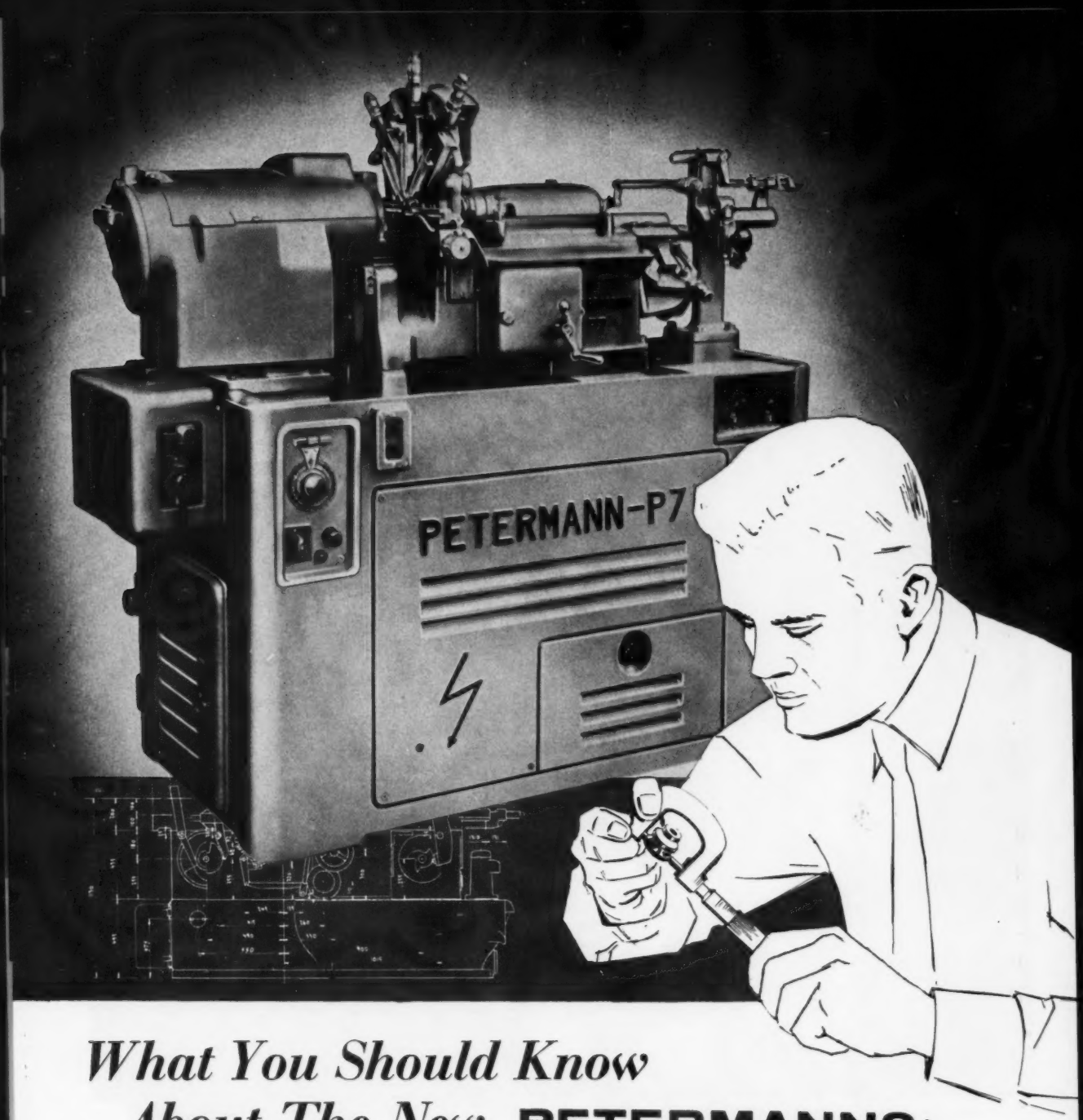


You no longer need rely on such a vague and indefinite human measuring standard as your individual operators sense of "feel" to determine whether thread ring gages (solid or adjustable) are bell mouthed and out of limits.

Pipe Machinery HILO Set Plugs are designed with two sections having different pitch diameters, but identical lead and angles. If the smaller end of the plug enters and the larger end is held out, the ring is the proper size. There's never any guesswork — never any cause for debate as to what constitutes a snug fit or acceptable shake.

For more complete information on these new, more accurate setting gages, write us on your company letterhead today.

THE PIPE MACHI[illegible] Lakeland Boulevard • Wickliffe, Ohio • Greater Cleveland



What You Should Know About The New PETERMANNS:

Many outstanding engineering advancements have been incorporated in the new Petermanns, one of the world's most renowned lines of Swiss Automatics.

Among their features are:

• Six- or four-spindle turrets with Ultra-fast indexing • Exclusive micro differential micrometers • Built-in gear box for both feed and spindle-speed settings • Headstock with "Nadella" needle bearings • Electronic cam shaft speed variator

CAPACITIES: 1/8", 5/32", 25/64", 5/8", 3/4", 1-1/16"

Engineered for U. S. Production; Built and Serviced with Swiss Precision.

Submit your machining problem with blueprints for analysis and recommendations.

Exclusive U. S. Representatives

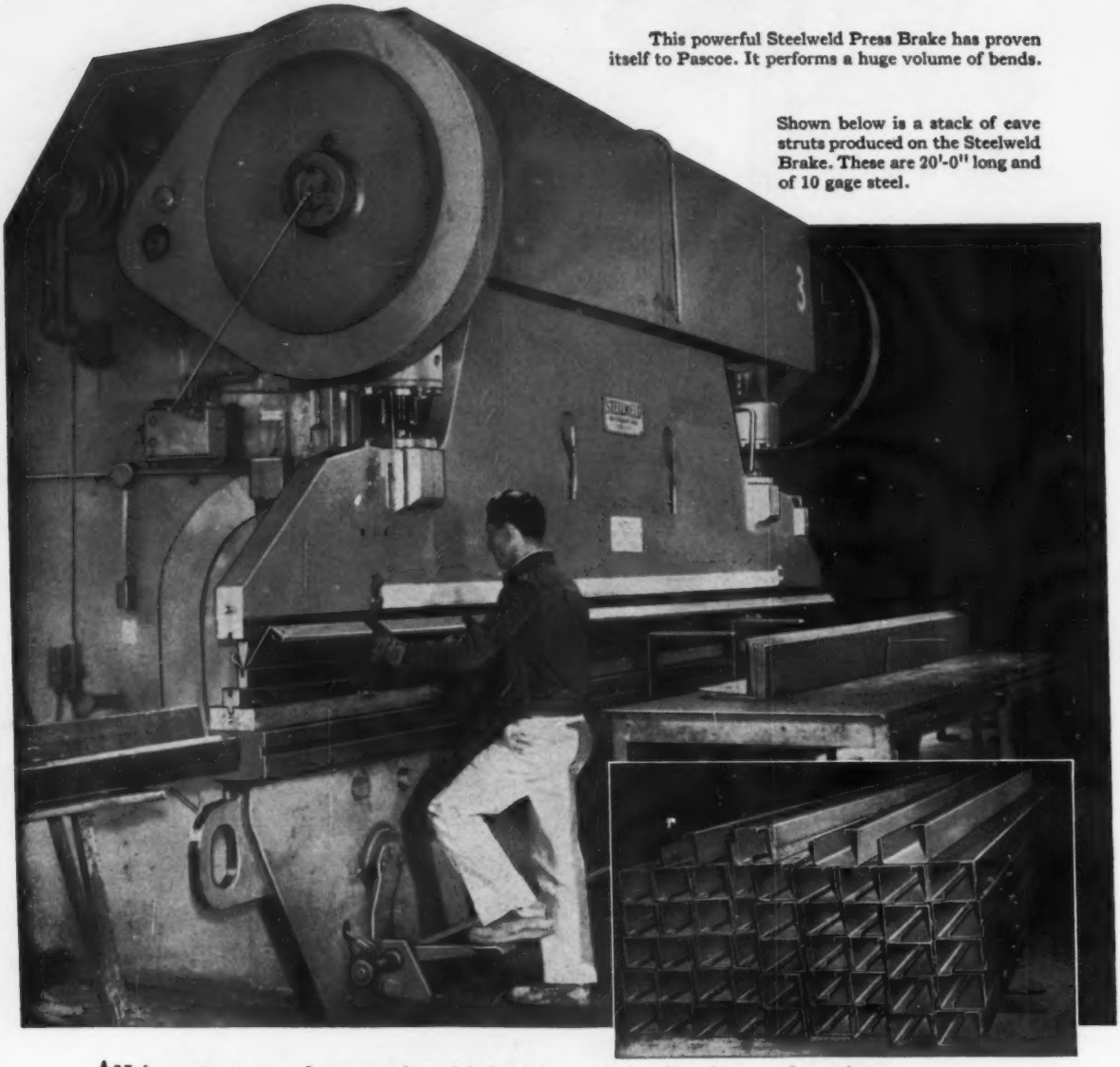
THE ARTHUR LOEFFEL COMPANY, INC.

MERRICK, N.Y. • TEL. FREEPORT 9-8600 Offices in Chicago and Los Angeles

STEELWELD BRAKE
AIDS PASCOE BUILDING PRODUCTION

This powerful Steelweld Press Brake has proven itself to Pascoe. It performs a huge volume of bends.

Shown below is a stack of eave struts produced on the Steelweld Brake. These are 20'-0" long and of 10 gage steel.



AN important manufacturer of prefabricated steel buildings on the West Coast, the Pascoe Steel Corporation, Pomona, California, keeps their Steelweld Press Brake going full tilt in order to keep up with the production schedule.

The brake normally handles steel up to 20'-0" x 3/16", although occasionally 1/4" metal is formed. It has the speed and power to produce sharp accurate bends at a fast rate.

Despite all the work put through, only the meagerest amount of maintenance is required. For instance, the clutch has had to be adjusted only once, every eight-month period and this can be done in very few minutes.

Pascoe builds a complete line of pre-engineered buildings which are used for warehouses, light manufacturing, grain storage, auditoriums, aircraft hangers, etc.

Write for free copy of catalog No. 2023A

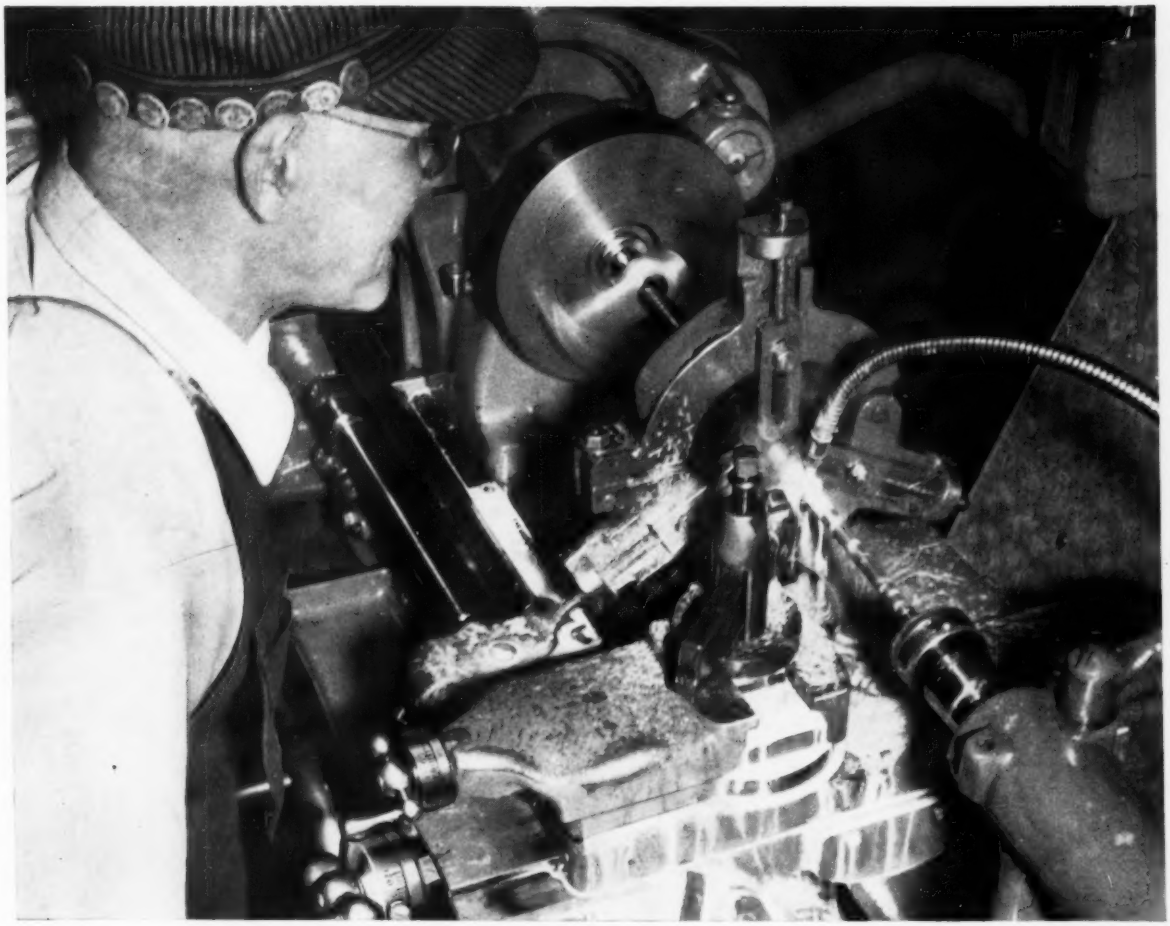
STEELWELD

Mechanical and Hydraulic

PRESS BRAKES

Steelweld Machinery includes: Shears and Press Brakes, One-, Two- and Four-Point Straight-Side Presses, Speed-Draw Presses.

STEELWELD MACHINERY DIVISION • THE CLEVELAND CRANE & ENGINEERING CO. • 5473 E. 281 ST. • WICKLIFFE, OHIO

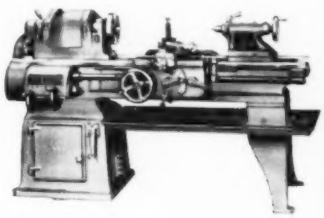


Dependability **you can count on** / *South Bend 16" engine lathe*

- Ruggedly designed, accurately built to give long trouble-free service.
- Exceptionally accurate—and they stay accurate.
- Microfinished sleeve type spindle bearings for smoother work, longer life, more accuracy, greater spindle support.
- Hardened and ground bed ways for extreme operating conditions available at small extra cost.
- Trouble-free belt drive to spindle—no noise, no vibration, no gear marks.

16" LATHE SPECIFICATIONS

Swing over bed and saddle wings — 16¼". Distances between centers (6 bed lengths) — 33", 45", 57", 81", 105" or 129". Collet capacity — 1 1/16" max. Spindle speeds — 6, 8, 12 or 16. Threading feeds — 48 (4 to 224 per in.). Longitudinal feeds — 48 (.0015" to .0841"). Cross feeds — 48 (.0006" to .0315").



Prices of South Bend 16" Engine Lathes start at $2591 f.o.b. factory.

Time payments—3¼% interest per year on unpaid balance, up to 36 months to pay.

SOUTH BEND LATHE

South Bend Lathe, Inc., South Bend 22, Indiana

Please send information on lathes, milling machines, shapers, drill presses and pedestal grinders.

Name _____ Title _____

Company _____

Street _____

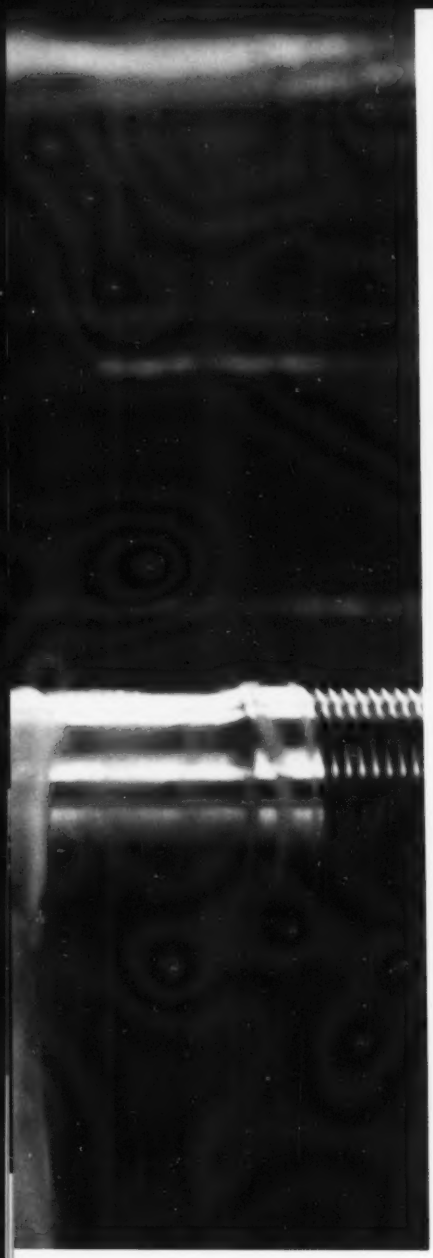
City, Zone, State _____

When the job calls for an emulsifiable Gulfcut® Heavy Duty Soluble Oil...

Gulfcut Heavy Duty Soluble Oil combines the ideal lubricating qualities of oil and cooling ability of water with special anti-weld additives that permit heavier cuts at higher speeds. It contains a special rust inhibitor that protects both product and equipment.

Superior finishes can be attained with Gulfcut Heavy Duty Soluble. It has been used to produce a 5-micron finish on steel—comparable to that of plate glass. On many tough jobs where other emulsifiable coolants have failed, Gulfcut Heavy Duty Soluble has delivered—even on low machinability metals.

CUTS MACHINING COSTS—With Gulfcut Heavy Duty Soluble Oil, a mixture of 1 part to 25 parts of water provides good cooling and superior lubrication. It has performed well even in mixtures of 1 to 100. In hard water, its excellent emulsion stability prevents separating or gum deposits on wheels, slides, ways or other machine parts. In soft water, a powerful anti-foam agent controls foaming. A germicidal agent counteracts possible rancidity and foul odor.



Lehmann 18" Hydratrol lathe turning 4" Nitralloy 135 modified bar stock. Tool is K7H carbide nitriding steel. Feed .011", depth of cut .100", speed 300 sfm. Coolant is 20% emulsion of Gulfcut Heavy Duty Soluble Oil.

Grinding 2" Type 970 steel gate valve wedges on a surface grinder. Shields removed and operation suspended to show grinding wheel and work pieces in place on stock table. This shop improved production more than 10% with Gulfcut Heavy Duty Soluble Oil.

◀ Norton Type C Cylindrical Grinder grinding SAE 4140 steel connecting rod bolts to 4 micro-inch finish. Speed is 225 sfm, depth of cut .020" with 30" x 1" aluminum oxide wheel. Coolant: Gulfcut Heavy Duty Soluble Oil in a 32:1 emulsion.

coolant, do it faster and better with GULF MAKES THINGS RUN BETTER!

Gulfcut Heavy Duty Soluble Oil can help you cut machining costs, improve production. May we have the opportunity to prove it to you? Just call your nearest Gulf office. Or, write us for literature.

GULF OIL CORPORATION
Dept. DM, Gulf Building
Houston 2, Texas

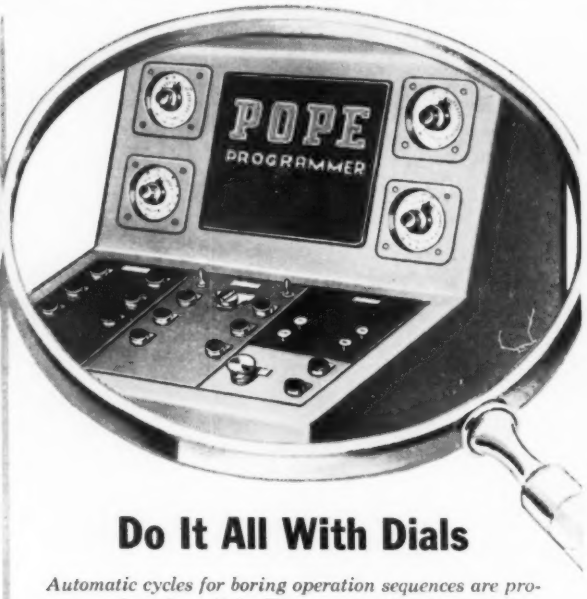
GULF

Since this shop began using Gulfcut Heavy Duty ▶ Soluble Oil, coolant service life increased 12 times.

SP-9988

YOU CAN INCREASE PROFIT AND PRODUCTION

with this new POPE 10-6 SUPER-PRECISION BORING MACHINE



Two Heads Are Better Than One

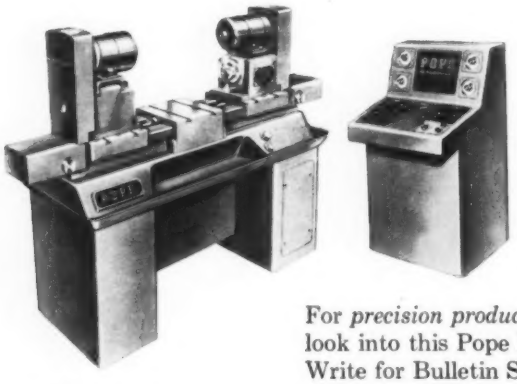
and of course you can have more than one spindle in each head. The Pope Model 10-6 features *two precision boring heads** operating completely independently of each other to provide simultaneous or alternate cycling movement of the heads. *This means increased production.*

*The Pope Boring Head Spindles on this machine revolve within 20 Millionths.

Do It All With Dials

Automatic cycles for boring operation sequences are programmed on these dials. The operator simply determines the sequence of operations and dials each one. You get continuous production of uniform parts in less time.

The Pope Electric Programmer gives you finger-tip fast control of infinitely variable speed, distance and operating sequence. You dial in the complete program with ease and speed that beats expensive numerical or tape control. Constant accuracy is maintained for cycle after cycle.



- Table dimensions—12" x 12'
- Maximum stroke, each head —6"
- Standard center height—5½" (variable)

No. 132

For *precision production at a profit* look into this Pope Model 10-6. Write for Bulletin S-21.

POPE®

ENGINEERS, DESIGNS AND BUILDS PRECISION ANTI-FRICTION BEARING SPINDLES FOR EVERY PURPOSE

POPE MACHINERY CORPORATION • 261 RIVER STREET • HAVERHILL, MASS.

Established 1920

Tool Steel Topics

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Re-draw die uses 36 pieces of water-hardening tool steel

This large re-draw die shapes an intricate rear floor pan, made of sheet steel, for an American-made automobile. The die contains 36 pieces of Bethlehem carbon tool steel which serve as wear plates, inserts, keeper blocks, and insert plugs. The 17-ton die was produced in the shop of Modern Die & Tool Co., Utica, Mich.

The wear plates and inserts were hardened to Rockwell C 58-60; the keeper blocks and insert plugs to Rockwell C 50-52. The die maker liked the die for its easy machinability and ease of heat-treatment; the automotive manufacturer liked its resistance to wear and shock, and superior weldability when changes were required.

Due to their controlled hardenability, Bethlehem carbon water-hardening tool steels are ideal for applications calling for high shock-resistance. They are also resistant to wear, and have the toughness to withstand cold battering.

Your Bethlehem tool steel distributor can help you to find out how good a job Bethlehem carbon water-hardening tool steel can do. And he can give you good advice on the selection of other fine Bethlehem tool steels. Give him a call now!

BETHLEHEM TOOL STEEL ENGINEER SAYS:

"Touchy" Tools Should Be Ground On Edge of the Grinding Wheel

A choice of grinding methods is often available on many types of tools. They can be ground either on the side (face) of a grinding wheel in order to cover the whole area to be ground; or they can be ground on the edge (OD) of the wheel by traversing a number of parallel paths to cover the area selected for grinding.

Where the tools to be ground are exceptionally high in hardness, or if they are made of wear-resisting steels, or if there is a history of sensitivity to grinding cracks, edge-grinding is definitely best. The use of a grinding fluid for effective cooling is also essential.

By grinding on the edge of a grinding wheel, only a small area of the wheel is in contact with the tool at any moment. This permits more effective cooling action of the grinding fluid than when a large area of the wheel contacts the tool.

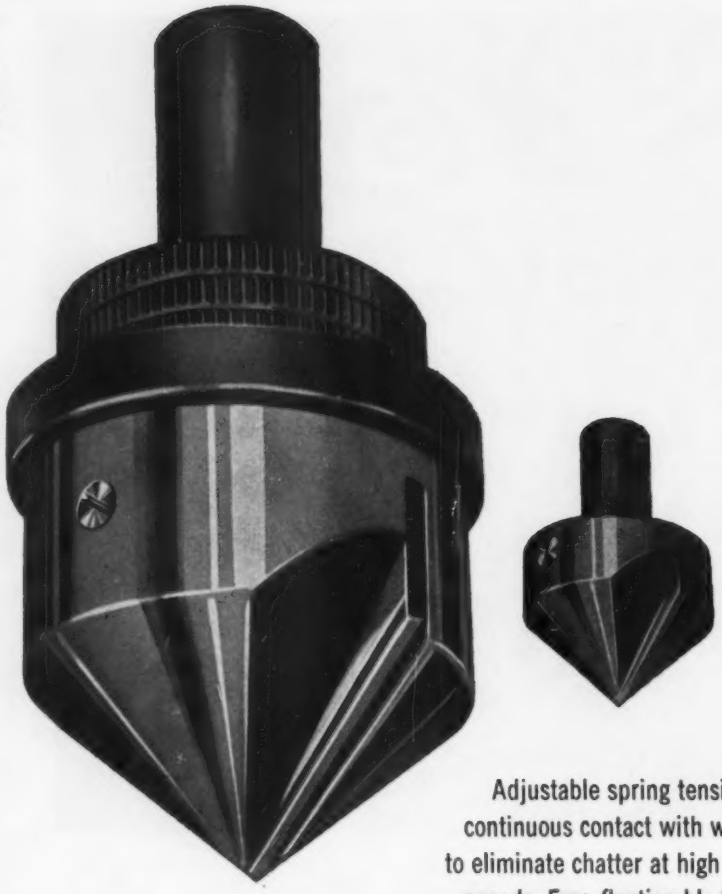
Cromo-High V (H-13)

Ideal for Die Casters

Die casters everywhere are getting fine results from Bethlehem Cromo-High V (H-13) tool steel. This 5 pet chrome-moly hot-work grade is furnished with 1 pet vanadium, and has all the features for good die-casting dies. Cromo-High V has good resistance to wash and erosion, and is plenty tough. It comes uniformly annealed for easy machinability. In addition, Cromo-High V has good center density and grain refinement, and resistance to heat-checking.

UNIVERSAL R & R DEBURRING TOOLS

with spring-loaded retractable blade give precision-cut edge or chamfer at high speed without chatter



Adjustable spring tension allows continuous contact with work-piece to eliminate chatter at high operating speeds. Free-floating blade permits self-alignment and uniform stock removal. Made in a full range of sizes to 1½" diameter.

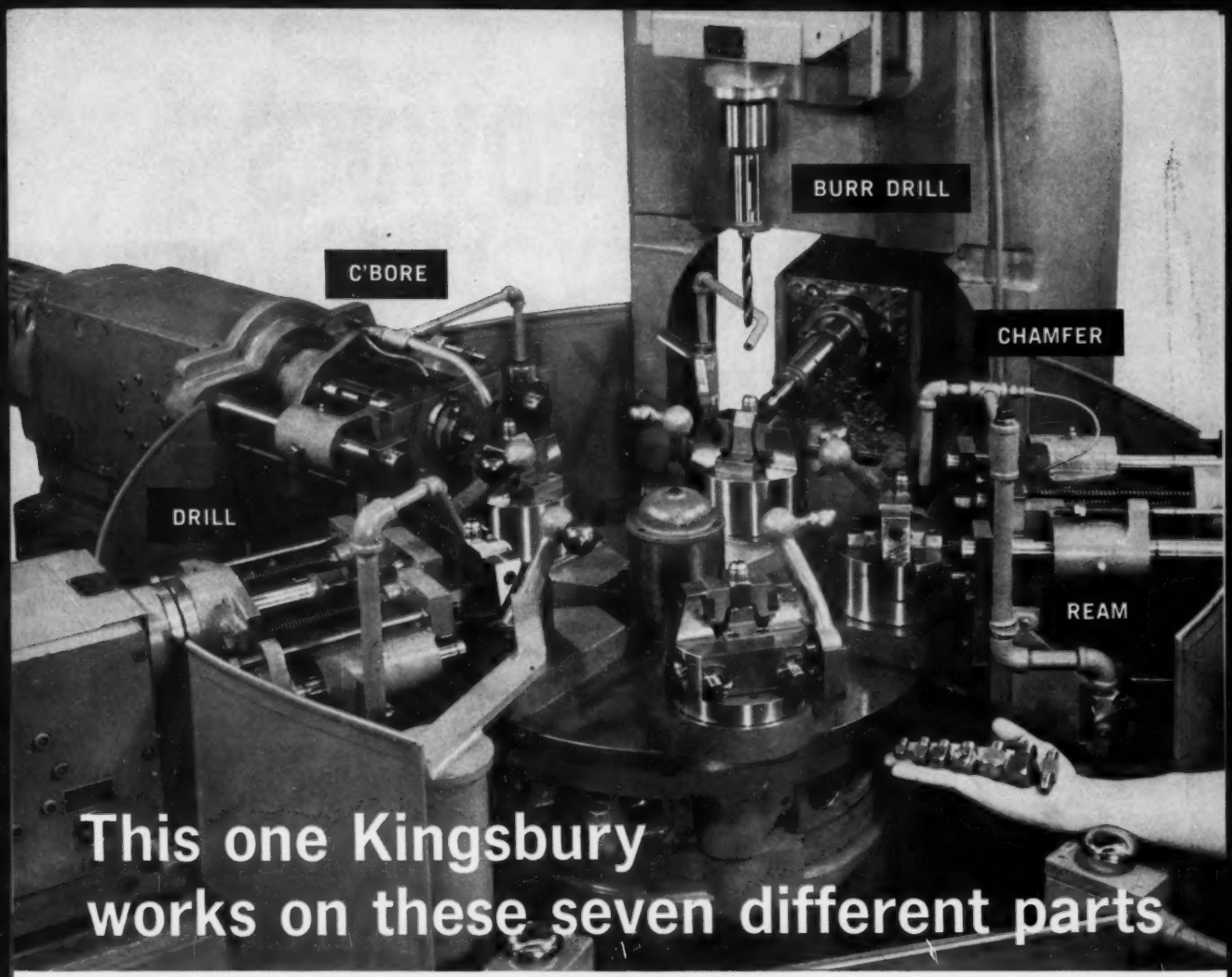
Blades of the Universal R & R Deburring Tool are made of high speed steel, precision hardened and ground to close tolerances for interchangeability. May be used as horizontal deburrer in portable electric drill or in standard drill press.

For full information, write to Universal Engineering Company.

Write today for complete catalog of Universal Engineering products.

216

UNIVERSAL ENGINEERING COMPANY • FRANKENMUTH 2, MICHIGAN

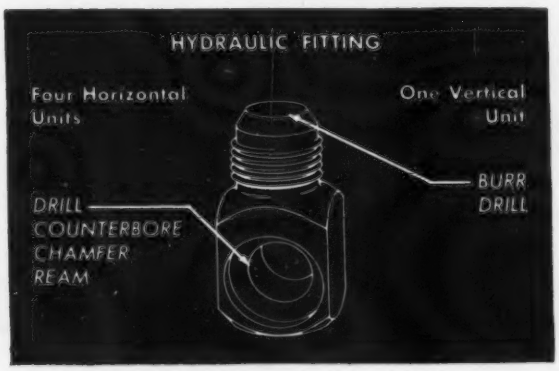


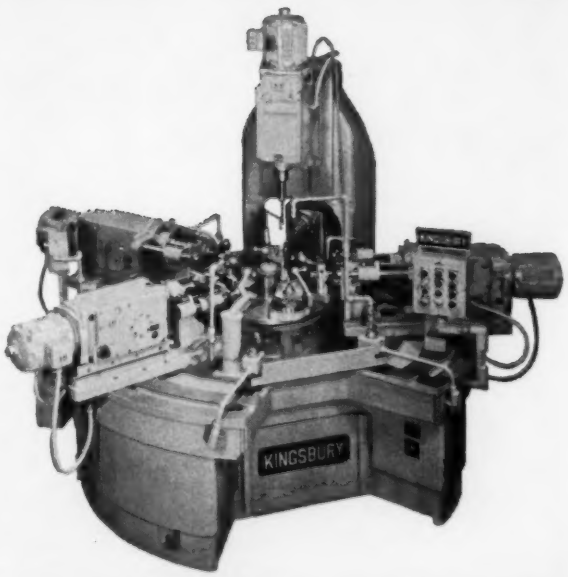
This one Kingsbury works on these seven different parts

This Kingsbury machine is fairly simple — just five units and six stations. The work pieces are held in two-jaw chucks with interchangeable locating jaws and clamps. The gross production rate for five parts is 500 parts per hour. On the sixth part it is 340, and on the seventh part with two chuckings it is 250 per hour.

Normally our machines are far more complex than this. But this one does show that our simpler machines also pay off. With good basic design and rugged accurate construction, they have little downtime. And uniform, accurate cycles produce little scrap.

May we quote you on a job, either simple or complex? Kingsbury Machine Tool Corp., Keene, New Hampshire.

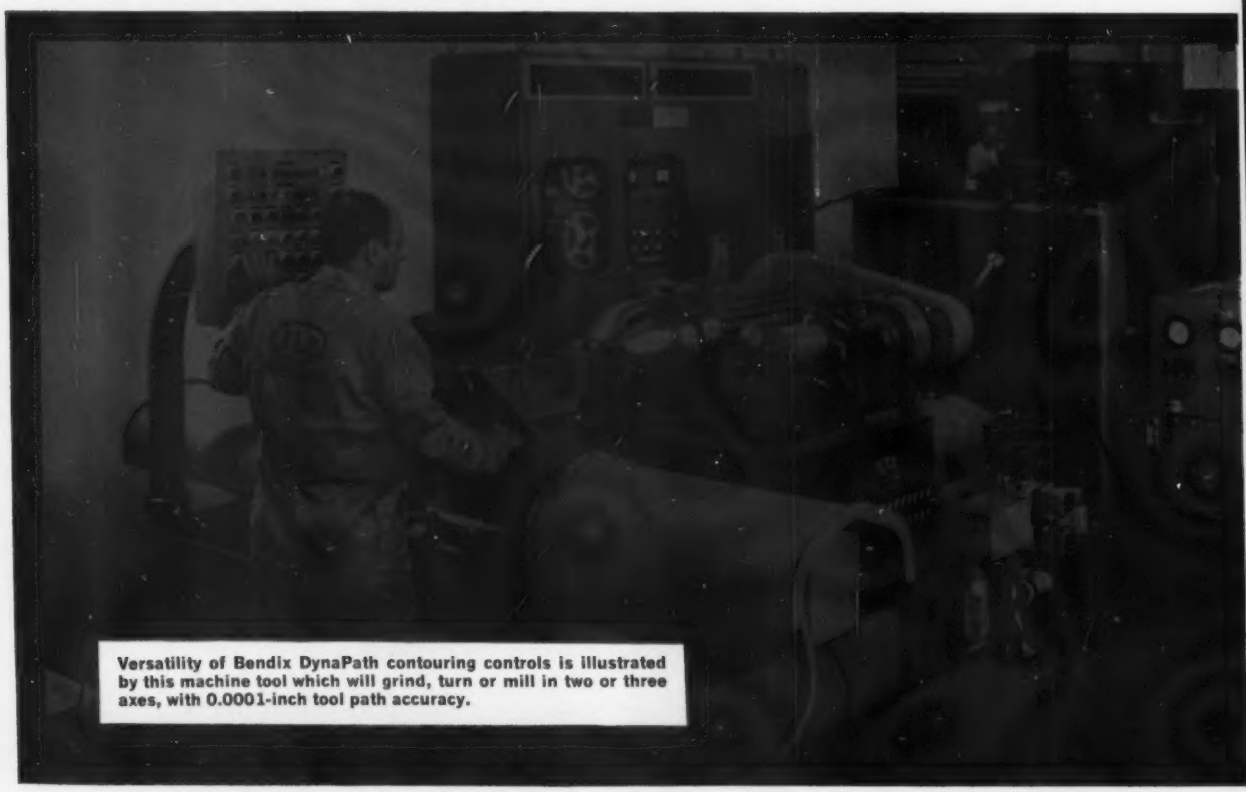




KINGSBURY MULTI-UNIT AUTOMATICS

BENDIX PROVIDES SYSTEMS EXPERIENCE TO MAKE NUMERICAL CONTROL WORK FOR YOU

Numerical control is a proved concept in metalworking. It has demonstrated its worth in scores of applications, but perhaps your manufacturing problems are different. Why not enlist the services of Bendix—long-time supplier of practical, reliable numerical control systems to most major machine tool builders. Let us be your prime source of information and assistance when the demand for increased productivity indicates a need for more modern equipment that will reduce scrap, reduce lead time, reduce inventory costs, and reduce tooling costs. Whether it's contouring, positioning or measuring, Bendix has the solution to your particular problem.



Versatility of Bendix DynaPath contouring controls is illustrated by this machine tool which will grind, turn or mill in two or three axes, with 0.0001-inch tool path accuracy.

YOU NEED BENDIX SYSTEMS EXPERIENCE when you consider numerical control for your application! Bendix offers:

1 JUSTIFICATION STUDIES—what can numerical control do for you?

2 SYSTEM ENGINEERING—applying the right control to the right machine tool.

3 TRAINING AND SERVICE—for maximum machine utilization rates.

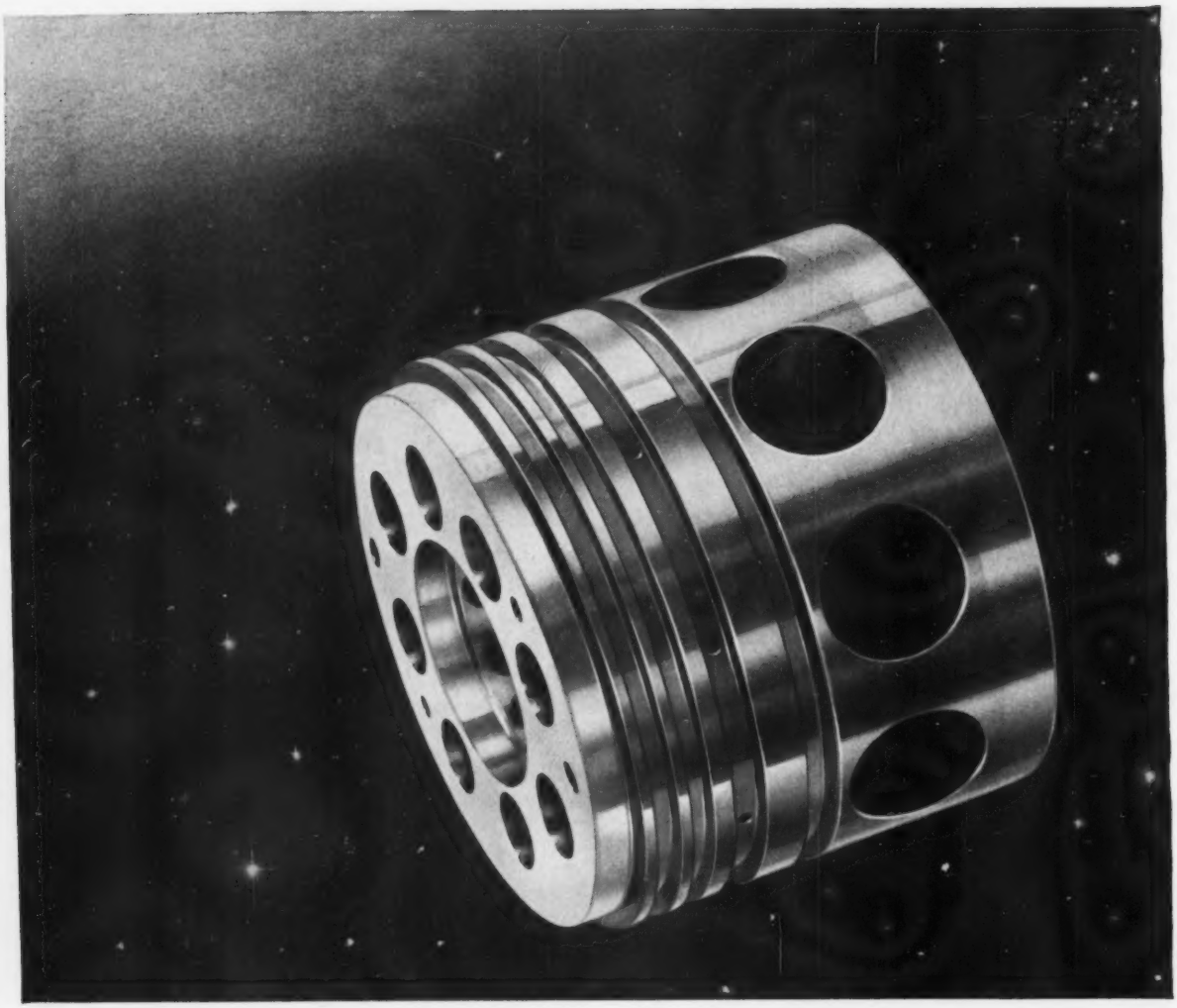
The unique Bendix Systems Experience is backed up by a staff of experienced electronic, mechanical and hydraulic engineers, mathematicians, instructors, technicians, and parts planners. Our contract machining and tape-making facilities offer years of accumulated case histories on all manner of applications *and* a chance to check out *your* problems in actual practice. Why not write today for more information on Bendix Systems Experience.

Industrial Controls Section
21820 Wyoming Ave., Detroit 37, Michigan

THE Bendix CORPORATION

Bendix
SYSTEMS EXPERIENCE
For tool room work, Bendix DynaPoint positioning systems can hold 0.0001-inch tolerances on this jig borer.
With Ferranti numerical control, this turret drill will do the work of several conventional machines, and reduce scrap.

For more data circle this page number on card at back of book



The New York Air Brake Co. reports...

"few rejections, superior quality for hydraulic pump with TIMKEN® steel"

Engineers at Watertown Division of The New York Air Brake Co. needed a Hi-Carbon Alloy Steel for production of this Stratopower 66W Series Hydraulic Pump and because this pump plays a vital role in guided missile and aircraft hydraulic systems, the steel had to be of superior quality and cleanliness.

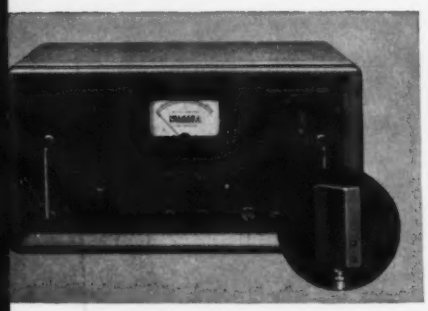
They consulted Timken Company metallurgists, who've been solving tough steel problems for over 40 years. After careful study, these experts recommended a special aircraft quality Timken® "52100" bar stock. The special characteristics and uniform high quality of every shipment of Timken "52100" provided consistent high quality finished parts.

One reason for the excellent results with Timken "52100" is the extremely rigid standards of magnaflux inspection we set for it. Another is—etch standards are super critical in regard to cleanliness and center porosity. And there's uniform response to heat treatment with minimum distortion.

Hundreds of tough steel problems have been solved with Timken fine alloy steel. Give yours to Timken Company metallurgists. Let us help you solve your steel problems. Call or write: The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Makers of Tapered Roller Bearings, Fine Alloy Steel and Removable Rock Bits.

TIMKEN®
Fine Alloy **STEEL**

NEW ADVANCEMENTS ON THE METAL FORMING FRONT

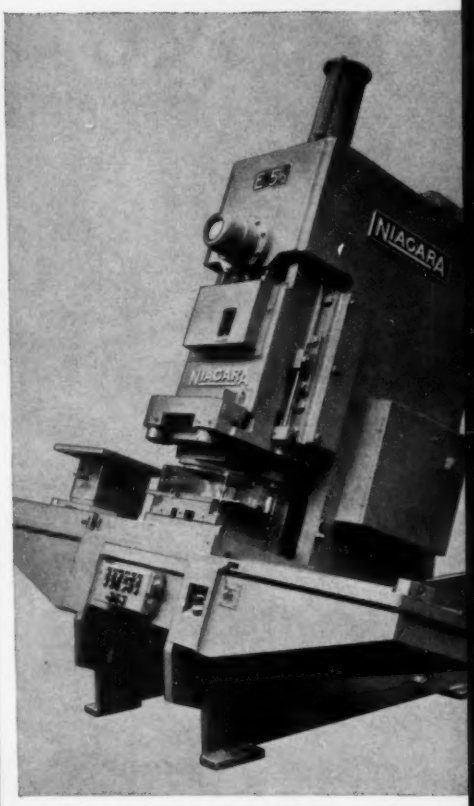


ELECTRONIC PRESS LOAD MONITOR ACTUATES SIGNAL OR DISENGAGES CLUTCH WHEN OVERLOAD OCCURS

Niagara's new Press Load Monitor, an electronic precision instrument, continuously measures and visually indicates all loads on a press during die setup or production. When a preselected press load is reached, a tripping circuit disengages the clutch to prevent overload repeats, or actuates a warning signal. Consisting of 2 or 4 pickups mounted permanently to press frames or tie rods, and a control unit located near the press, Load Monitor instantly indicates press loads from 0 to 140% of press capacity regardless of press speed. Key-locked controls prevent tampering by unauthorized personnel. Request *Product Report No. 2.*

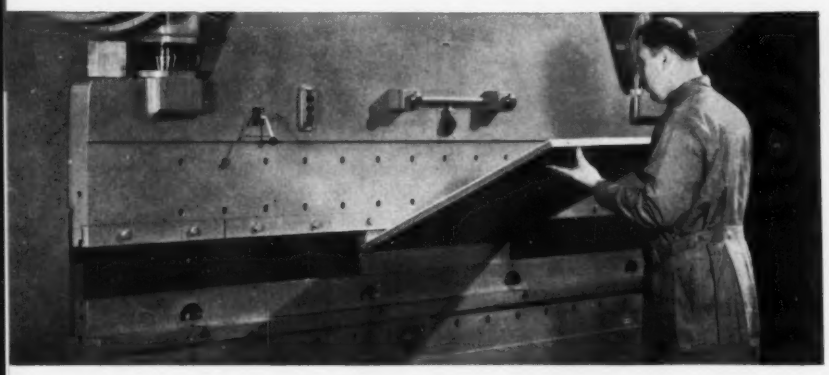
PORTABLE ELECTRONIC TONMETER MEASURES LOADS TO SAFEGUARD DIES AND PRESSES

The Niagara Portable Transistorized Tonmeter is an accurate, fast-response instrument for measuring loads imposed on a press or battery of presses during production or die setup. Pickups placed on press frames sense the intensity of loads. Large indicator, reading in percentage of press capacity, shows the maximum load during the press cycle. Because battery-powered unit requires no electrical outlet and is easy to carry, one individual can check several presses in minutes. Unit is designed to prove its calibration and test its own battery to be sure operating power is within prescribed limits. Request *Product Report No. 2.*



SLIDING BOLSTER PRESSES SLASH DIE CHANGEOVER TIME

Niagara presses arranged with Sliding Bolsters save hours of setup time on work requiring frequent die changes. On inclinables, straight sides, or other Niagara presses, sliding bolsters permit die removal or replacement in minutes instead of hours. Floating on a "cushion of air," dies can be easily moved into and out of work area by hand. Optional features for the slide may include power or manual die clamps, power or manual slide adjustment, shut height position indicator, semi-automatic slide positioner. Request *Product Report No. 1.*



AUTOMATIC STROKE CONTROLS PREVENT PRESS BRAKE "WHIP-UP"

Two automatic stroke control systems recently developed by Niagara are making new press brake efficiency and operating safety a reality.

The first, an Alternating 2-Speed Stroke Control, for press brakes with air clutches, increases production by providing a positive means of avoiding "whip-up" and "back bending" during high speed operations involving wide sheets. Following a fast approach, ram speed is automatically reduced during the working portion of the stroke, then automatically increased for a fast return to top of stroke. Because slipping the clutch is no longer necessary, less operator skill and experience are required. Clutch burnouts are prevented. Work spoilage resulting from back bends is eliminated. Selector switch offers choice of three stroke-speed combinations. Request *Product Report No. 3.*

The second, an Automatic Ram Arrestor, is available for both air and mechanical clutch machines. Following a fast approach, ram is automatically *stopped* at a predetermined point just before it touches the work. Ram can then be "inched" through the bending portion of the stroke, avoiding whip-up and back bending. It may then be returned to top of stroke at high speed. Since inching is confined to such a small portion of the stroke, operating cycle is faster... operator fatigue and clutch wear are reduced. Even inexperienced operators can perform safely and efficiently with minimum work spoilage. A single adjustment permits the stopping point to be matched to die and material. Request *Product Report No. 3.*

NIAGARA

NIAGARA MACHINE & TOOL WORKS
683 Northland Avenue, Buffalo 11, N. Y.

For more data circle this page number on card at back of book

MRC

MARLIN-ROCKWELL

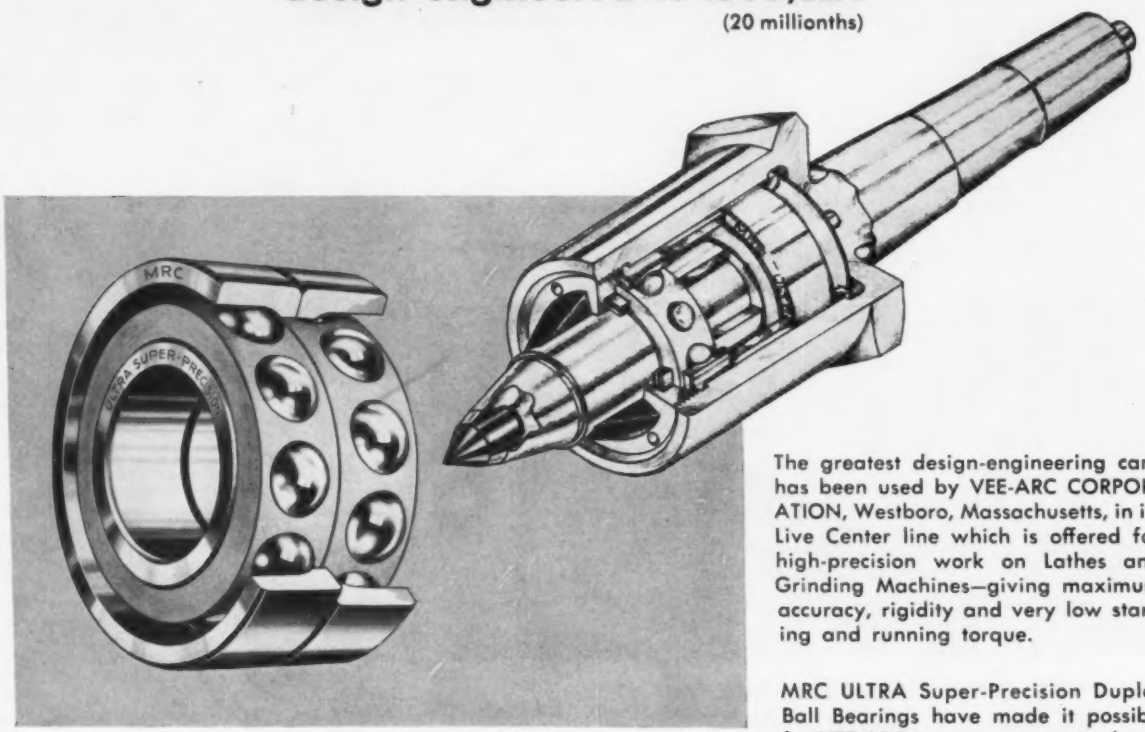
RELIABILITY

COUNTS

IN VEE-ARC SUPER-PRECISION Live Centers..

design-engineered to .000,020"

(20 millionths)



The greatest design-engineering care has been used by VEE-ARC CORPORATION, Westboro, Massachusetts, in its Live Center line which is offered for high-precision work on Lathes and Grinding Machines—giving maximum accuracy, rigidity and very low starting and running torque.

MRC ULTRA Super-Precision Duplex Ball Bearings have made it possible for VEE-ARC to guarantee a total run-out accuracy of 20 millionths of an inch, combined with low starting and running torque.

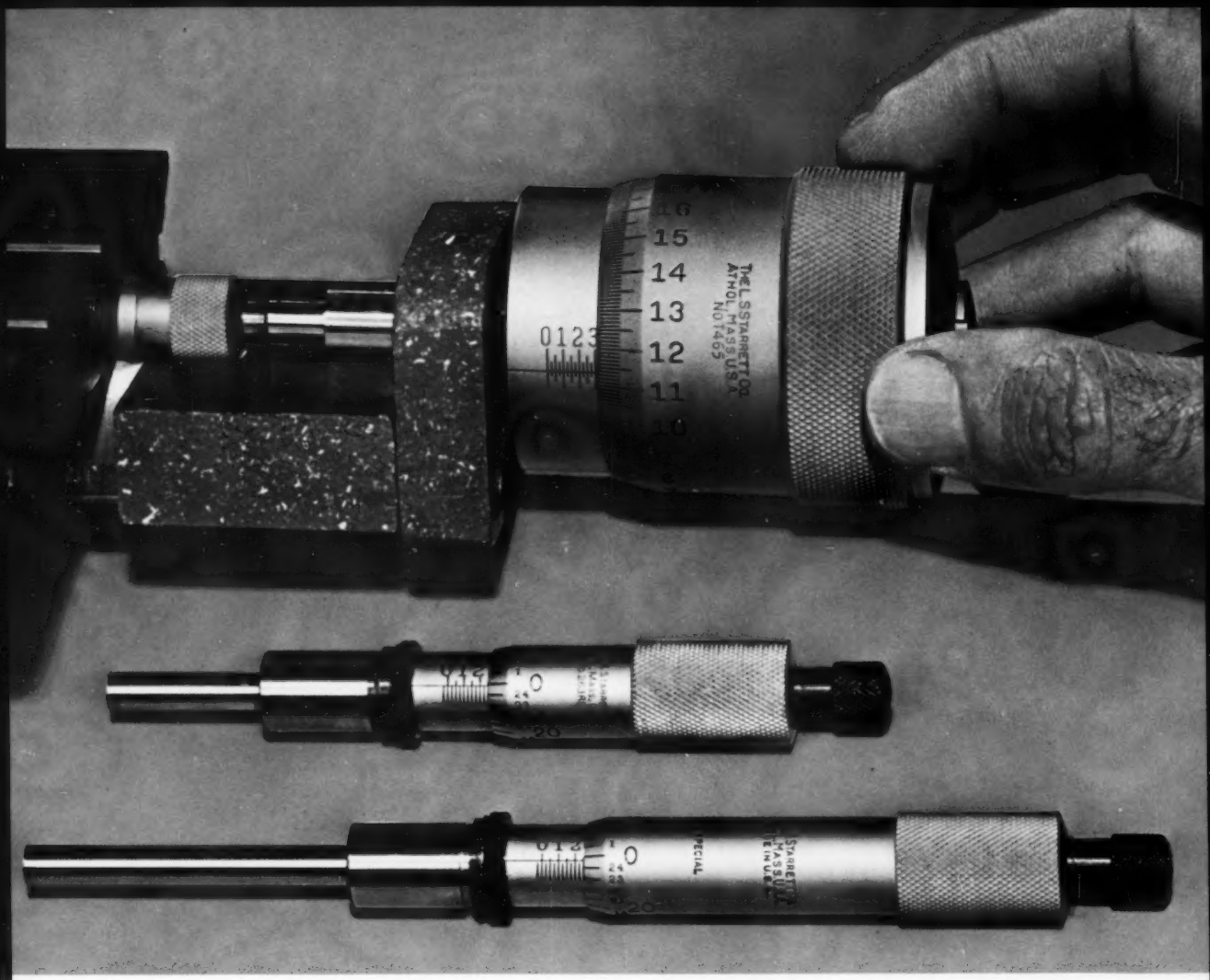
MRC pioneered, developed and produces ULTRA Super-Precision Ball Bearings to provide the ultimate in accuracy.

Consult OUR Engineering Department on YOUR Bearing Problems

MRC BALL AND ROLLER bearings

MARLIN-ROCKWELL CORPORATION

Executive Offices: **Jamestown, N. Y.**



PRECISION TOOLS — No. T465 SATIN-CHROME 0-1" Micrometer Head with 2¼" thimble, 9/16" x 1" dia. clamping surface, tenth graduations; No. 263RL 0-1" and No. 63RL 0-2" Micrometer Heads, both with ¾" x ½" dia. clamping surface.

Starrett® micrometer accuracy packaged to suit your needs

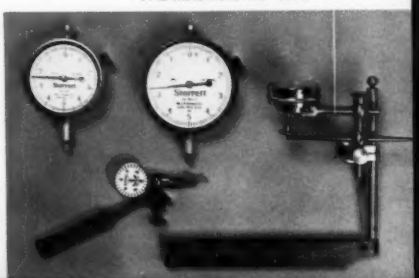
Starrett is the logical source for micrometer heads for mechanical or electronic applications. As with many other fine Starrett tools and gages, they are available in a wide choice of standard models or with special variations from standard to suit your exact requirements. Available through your nearby Industrial Supply Distributor or for special heads through the Starrett Special Order Department. Call him or write for complete Catalog No. 27. Address Dept. D, The L. S. Starrett Company, Athol, Massachusetts, U.S.A.

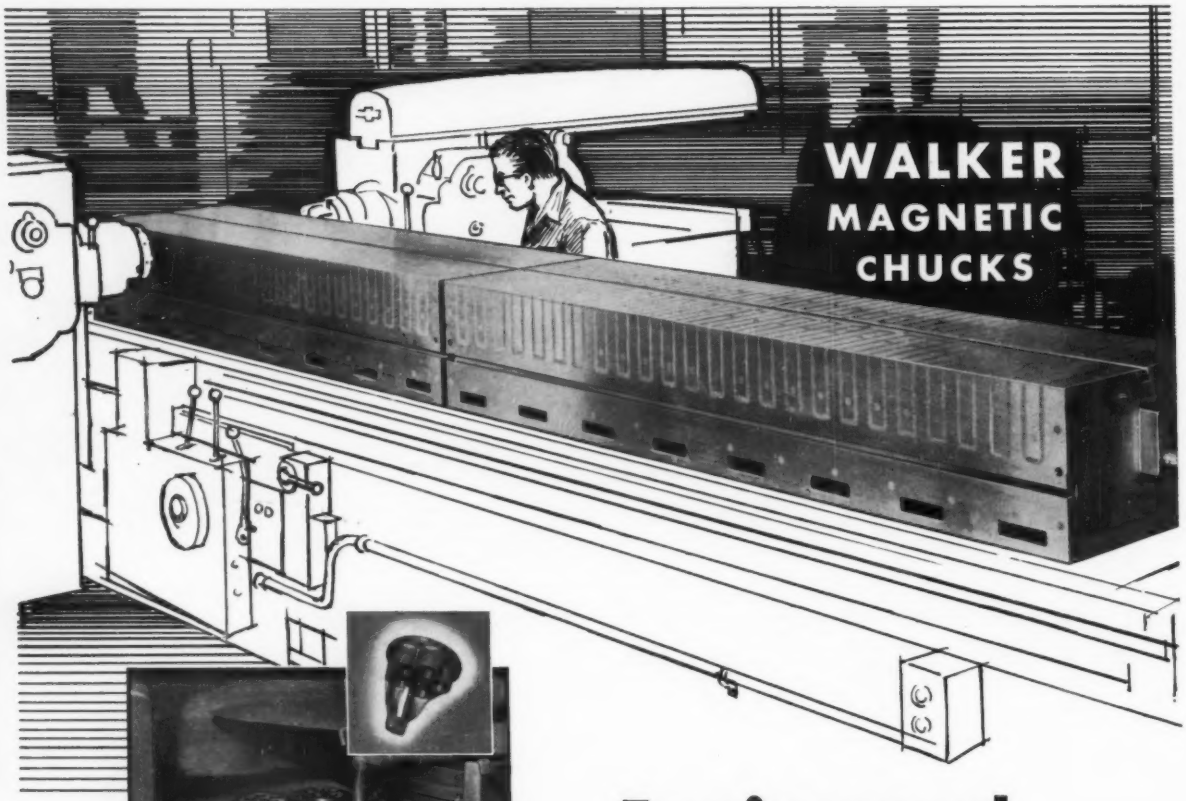
World's Greatest Toolmakers

PRECISION GROUND DIE AND FLAT STOCK

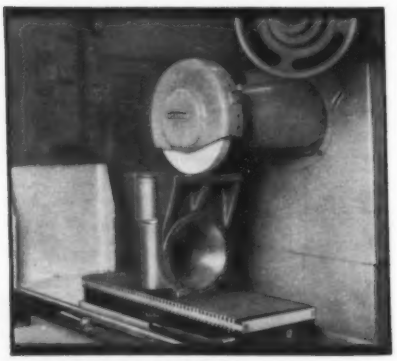
HACKSAWS, HOLE SAWS, BAND SAWS, BAND KNIVES

DIAL INDICATORS AND GAGES





SPECIAL ROTARY
A special rotary auxiliary plate with cylindrical magnetic raising blocks holds irregularly shaped parts of grinding with quick easy set ups.



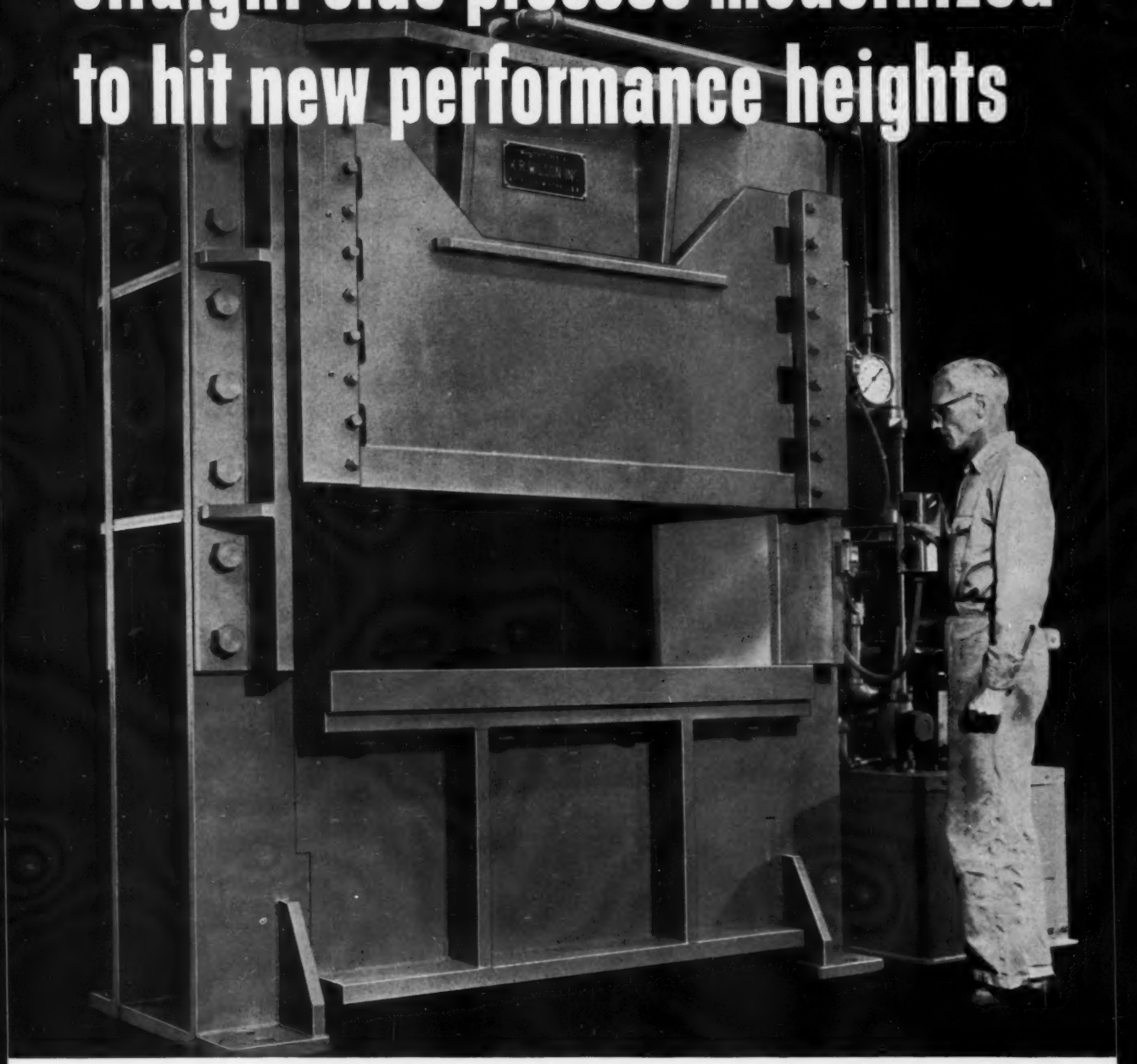
CERAMAX PERMANENT
A rugged Walker "Ceramax" chuck with ultra permanent ceramic magnets holds a large part for precision grinding.

Engineered MAGNETIC Applications

Walker engineers are continuously solving *new* holding problems for industry. The three-faced electromagnetic chuck above is only one example of the special designs created by Walker ingenuity and "knowhow". Whether you need any one of the complete line of standard magnetic chucks or a specially designed item, your best source is Walker.

O.S. Walker Co., Inc.
ROCKDALE ST. • WORCESTER 6, MASS.
Original Designers and Builders of Magnetic Chucks

straight side presses modernized to hit new performance heights



Here's smooth hydraulic action at its best! Newly modernized, the KRW 25-1000 ton line of straight side, single action presses offers you the most profitable answer to a wide range of work: bending, forming, blanking, briquetting, broaching, coining, embossing, forging, straightening and trimming.

Boasting clean-cut, neat exteriors, these versatile machines have been engineered to improve productivity . . . *quantity-wise, quality-wise and dollar-wise!*

KRW's rugged, welded frame construction is unequalled for strength and rigidity. Members are keyed and fitted together to insure precision performance. Angle gibs, located at each corner of the sliding platen, maintain platen-to-bed parallelism to make utmost accuracy and longer die life a certainty.

Available with either up-acting or down-acting platens, KRW Straight Side, Single Action Presses can be outfitted with manual lever or electric push buttons for single or continuous cycling. Compact, easy-to-adjust and fully responsive, KRW hydraulic systems assure instant, complete press control.

More detailed information (including specs) can be obtained by writing for illustrated Bulletin 5-B. K. R. Wilson, Inc., 214 Main St., Arcade, N. Y.

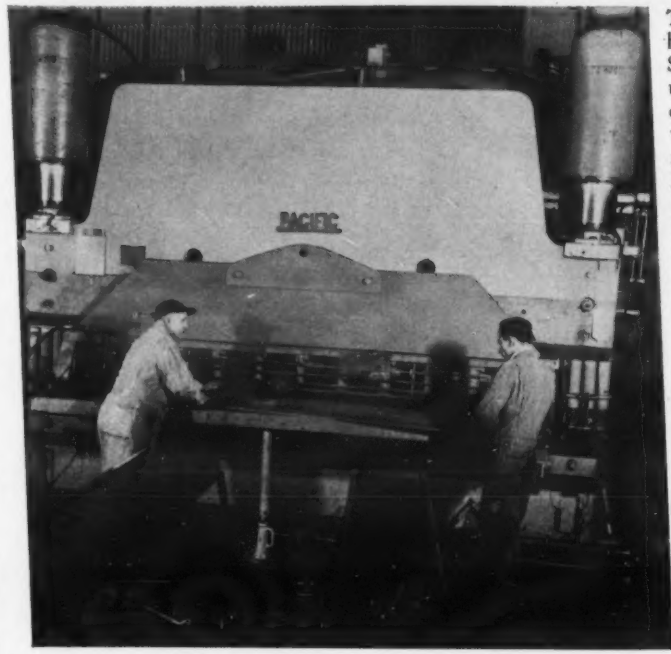
KRW HYDRAULIC PRESSES

15 years engineering and millions of dollars invested* to perfect the world's finest brake... today's PACIFIC HYDRAULIC PRESS BRAKE

Over 9 out of every 10 hydraulic press brakes in operation today are PACIFIC providing...

- More dependability
- Freedom of maintenance and leakage
- Simpler electric controls
- Simpler hydraulic control
- More accuracy in level control
- More accuracy in air bending
- More operating convenience
- Greater visability
- More rigidity in cylinder construction
- Shock-free hydraulic system suitable for punching

Shearing attachment increases press brake productivity 65%



The Pacific hydraulic press brake at Wyatt & Kipper, Seattle, Wash., was formerly used only 15% of the time during regular 40 hour weeks in bending plate and special forming. By adding a Pacific shearing attachment to perform cutting that had been previously burned or jobbed out, brake utilization increased to 80% and the need for a separate $27,000 shear was eliminated. By forming and shearing on the same machine, an additional $600 a year cost for floor space otherwise required is saved. With a single connecting load charge, power costs are substantially less. Shearing attachment takes only 12 minutes to install; 7½ minutes to remove. Cuts 10 gauge sheet to 5/16" stainless or ½" mild steel easily. On production jobs, machine cuts as fast as steel can be moved.

*THIS INVESTMENT ENABLED PACIFIC TO INTRODUCE:

- Tape control to synchronize cylinders within .003" (1947)
- Cushioned punching (1949)
- Precision depth control to repeat accuracy within .001" (1951)
- Manual turret stroke controls for progressive bending (1952)
- Selective anti-whip speeds to eliminate reverse bends (1952)
- Tandem operation of press brakes for forming pieces 40 ft. or longer (1953)
- Tonnage control to protect light dies in heavy press (1953)
- Multiple hydraulic cushion cylinders for deep drawing (1954)
- Overhead integral power unit for increased accuracy (1955)
- Cylinder ram guides for increased rigidity (1956)
- Shearing attachment for shearing heavy plate on press brake (1958)
- Pipeless stacking of valves to eliminate pipe breakage and leakage (1959)
- Shockless hydraulic valving to eliminate cause of leakage (1959)

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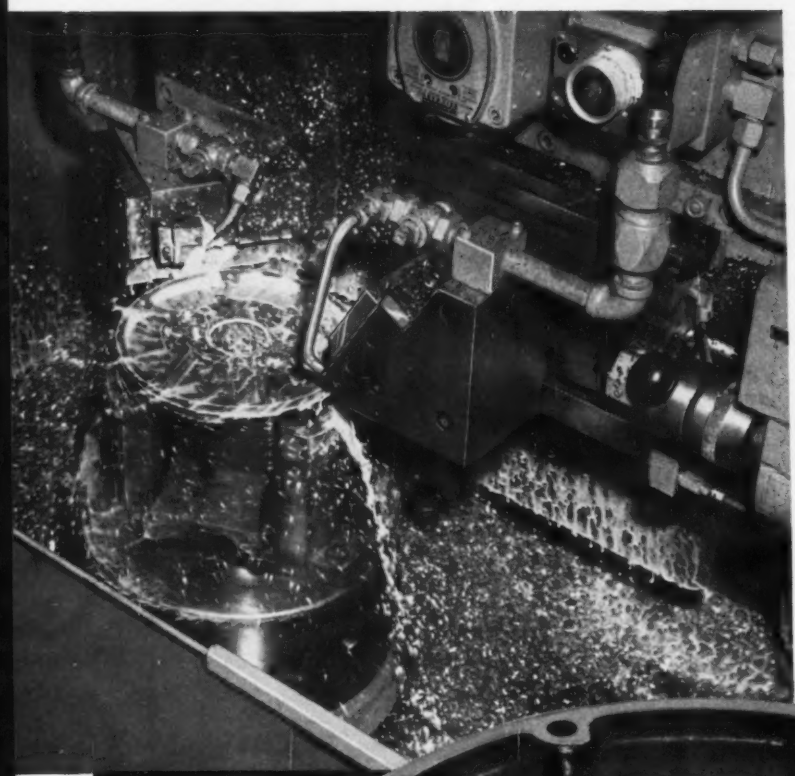
CHIPS FLY on the super-powered VERTICAL TURNER



It takes a machine tool with real "guts" to stand the shock of hour-after-hour high speed production on a tool-shattering interrupted cut like this. Special work-holding fixtures were attached to the spindles to automatically locate and clamp the automotive part solidly.

Cutting tools move smoothly through this complex casting like knives through putty, roughing to an average depth of 3/16" at 142 rpm. Tools feed at .020" per revolution.

On a second machine this part is finish-faced and bored at 300 rpm with a cut .015" deep. Tolerances are held to ±.001" in boring and facing. Production rate is 42 pieces per hour; both machines are controlled by a single operator.

The rigid base and column castings and other components of the Vertical Turner are produced in lots and are adaptable to your specifications—saving you dollars. Countless tooling attachments can do an endless assortment of machining jobs. The Vertical Turner has proved to be one of the most rugged metal removers ever built for low-cost, precision production turning!

Write for free catalog

Check the facts! Learn how the Vertical Turner, custom-assembled from production-made components to effect huge savings in capital investment, also makes great savings through improved accuracy and higher production rates.

MOTCH AND MERRYWEATHER

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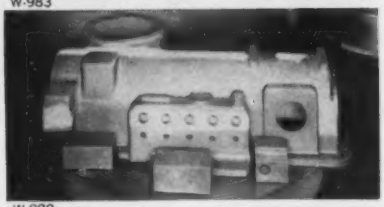
W-983



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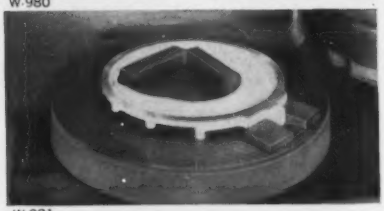

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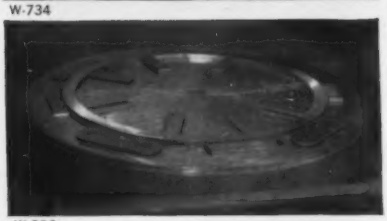

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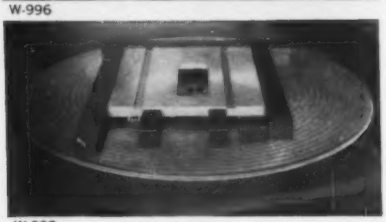

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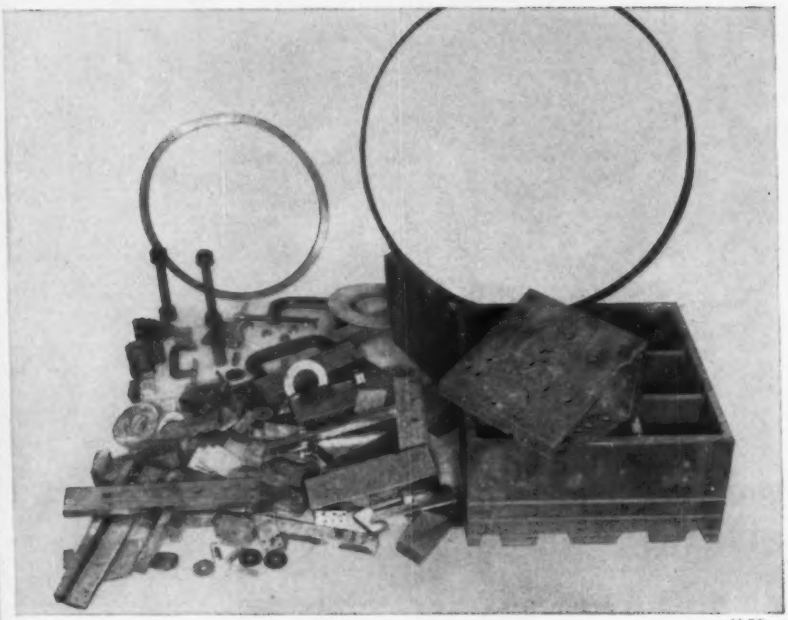
BLANCHARD GRINDERS



M-59

Use Industry's Least Expensive Fixtures . . .

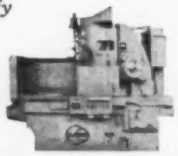
Normally, the Blanchard magnetic chuck will hold ferrous work pieces during the grinding cycle.

But when fixtures *are* needed — for holding irregular-shaped objects, whether ferrous or non-ferrous — you can usually select your "fixtures" from the nearest scrap pile.

For high-speed production, close-tolerance finishes and the most versatile grinding capabilities in existence . . . *put it on the Blanchard!*

Write today for your free copy of "Work Done on the Blanchard", Fifth Edition, and "The Art of Blanchard Surface Grinding", Fourth Edition.

For Best Results, Always Specify Blanchard Grinding Wheels for Blanchard Grinders.



No. 18

PUT IT ON THE BLANCHARD

THE BLANCHARD MACHINE COMPANY

64 State Street, Cambridge 39, Massachusetts

LOW COST PORTABLE ELECTRONIC GAGING UNIT

Now more compact, more versatile, easier to use . . .

Feather-light touch Extremely low contact pressure — less than 2.5 grams — so light you can gage dependably to high accuracies using test set stands or even more conveniently, the new, low cost wide range height stand illustrated.

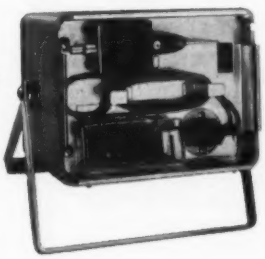
New Contact Tip Design New tip profile permits accurate measurements, without applying correction factors, even with finger at 20° angle to work.

Faster Zero-Setting Two-speed knob provides both long range electrical zero adjustment (over .008″) and fine setting. Each Electro-probe has two ranges (±.002″ and ±.001″ for one model and ±.001″ and ±.0002″ for the other). Other magnifications available. Scales are correlated; zero setting will not change when switching magnification.

Battery Life Quadrupled New transistor amplifier design gets over 1200 hours life from mercury cell battery (up to 2 years normal use). Can also be operated from pen size mercury cells or regular carbon type batteries. For continuous use, a battery eliminator can be furnished for 115 volt operation.

Improved Meter Visibility Adjustable legs, which double as carrying handles, permit placing meter at any angle for best visibility. The fine line graduations and hair-line pointer provide easy, precise readings.

Completely self-contained Rugged meter housing contains all amplifier components (transistors and printed circuit card) so unit can be mounted in a panel if desired. When used as portable unit, gage head can be removed and mounted without disturbing plug connection, and back cover replaced while head is in use. Small plastic box within housing contains holding and mounting accessories.



Rear view with cover off.

For demonstration or brochure, write
FEDERAL PRODUCTS CORP., 1112 Eddy Street, Providence 1, R. I.

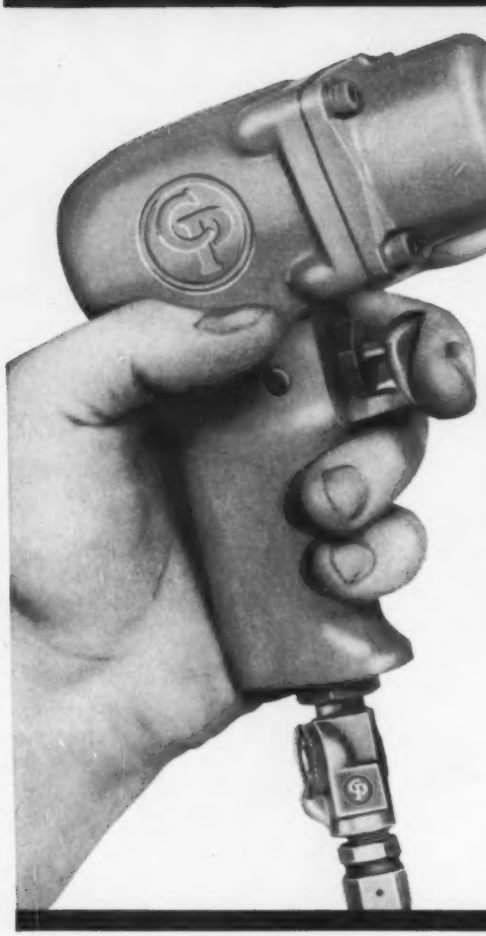
Ask **FEDERAL** *First*

FOR RECOMMENDATIONS IN MODERN GAGES . . .

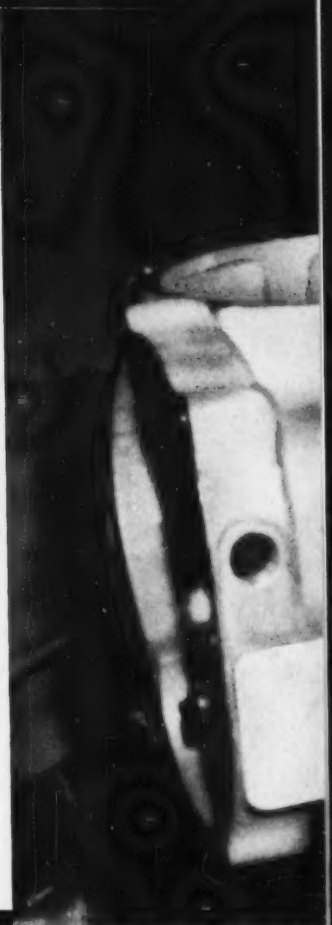
Dial Indicating, Air, Electric, or Electronic — for Inspecting, Measuring, Sorting, or Automation Gaging

For more data circle this page number on card at back of book

Newest addition to industry's MOST PRODUCTIVE



ALL NEW
CP-6020
¼" BOLT SIZE
IMPACT WRENCH
⅜" SQUARE DRIVE



The new CP-6020 is designed specifically to handle the popular ¼" bolt size with plenty of power and sock to meet any production schedule.

A real production line tool, this little wrench has 50% more power than previous models . . . gives you faster rundowns . . . longer tool life on repetitive jobs.

Power regulator provides adjustable power control to meet wide variety of assembly requirements.

Eight models available with choice of lever or offset handle, ⅜" square drive shank or three sizes (¼", 5/16" and 7/16") of hex. slip chucks.

Features include:

- *Light weight* . . . less than 2¼ lbs.
- *Styled for holding comfort* . . . easy maneuvering in tight spots.
- *Low clutch maintenance* . . . oil lubricated, more efficient, longer wearing . . . easier to service.
- *Convenient reverse valves* . . . the hand that holds the tool controls the reverse . . . other hand always free.

If your requirements call for a ¼" bolt size capacity Impact Wrench, it will pay you to look into the CP-6020. *Write for: SP-3270, today.*

OTHER CP BOLTING "PROBLEM SOLVERS"

Whatever your assembly problem, if it involves bolting, you'll find a CP Air Impact Wrench designed to handle the job quickly and economically . . . to exactly suit your requirements. The full line includes 52 different models with capacities ranging from ¼" to 1¾" bolt size.

Torque Control Models to meet "specified torque settings" are available. With this feature the wrench automatically ceases to impact the moment proper torque is reached.

Typical CP production line Air Impact Wrenches are shown at the right. For full details, write to: *Chicago Pneumatic Tool Company, 8 East 44th Street, New York 17, N. Y.*

LINE . . . the CP-6020 IMPACT WRENCH!

FOR 3/8" BOLT SIZE

CP-3440 Heavy Duty, Reversible Impact Wrench. Choice of side or lever handle, ½" square drive or 7/16" integral hex. chuck. 90° Angle Head model with lever handle available for those hard-to-reach jobs.

FOR 5/8" BOLT SIZE

CP-3490 Heavy Duty, Reversible Impact Wrench. Choice of side or pistol grip handle, 5/8" square drive or 7/16" integral hex. chuck. Angle Head models available. Head can be used in any one of four 90° positions. All models are furnished with an adjustable power regulator.

FOR 3/4" BOLT SIZE

CP-3630 Heavy Duty Reversible Impact Wrench. Choice of side or pistol grip handle, ¾" square drive shank. Angle Head model, as shown, available for those "hard-to-reach" jobs. Integral 5/8" hex., quick change chuck available.

Chicago Pneumatic *8 East 44th Street, New York 17, N. Y.*

PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES • HYDRAULIC TOOLS • VACUUM PUMPS

For more data circle this page number on card at back of book

Metallurgical Memo from General Electric

Pick the one you need . . . there's a G-E Carboloy® toolholder for every metalcutting purpose

Designed to do a better job more efficiently, Carboloy toolholders help you get BETTER PROFITS THROUGH BETTER TOOLING

Even the very finest cemented carbide inserts (Carboloy carbides) can't do a decent machining job if the toolholder is inferior.

That's why the Metallurgical Products Department of General Electric has evolved a line of toolholders to do a superior job in every metalcutting operation. Carboloy toolholders get the mileage out of inserts . . . take the headaches out of machining.

Choose from: Lift-O-Matics, with self-raising chipbreaker clamp (positive rake, negative rake – 20 styles, 186 sizes total); Adjust-O-Breakers, with the chipbreaker versatility of *many* toolholders (negative rake – 10 styles, 30 sizes); Tracers (positive rake, negative rake – 8 styles, 19 sizes total); Heavy-duty (8 styles – 10 sizes).*

These, along with the complete line of Carboloy inserts, insert seats, convertible seats, and brazed tooling, are all designed to help you attain "BETTER PROFITS THROUGH BETTER TOOLING." Check with your Authorized Carboloy Distributor today. Or write: *Metallurgical Products Department of General Electric Company, 11147 E. 8 Mile Ave., Detroit 32 Michigan.*

**Available through Canadian General Electric Company, Limited, Toronto, Ont., and through International General Electric Company Division, General Electric, International, New York, N.Y.*

CARBOLOY®
CEMENTED CARBIDES

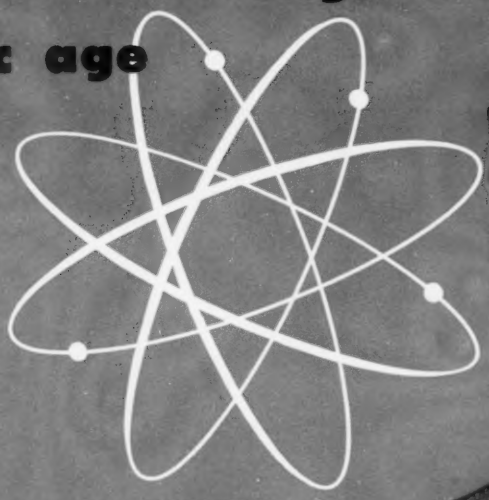
METALLURGICAL PRODUCTS DEPARTMENT

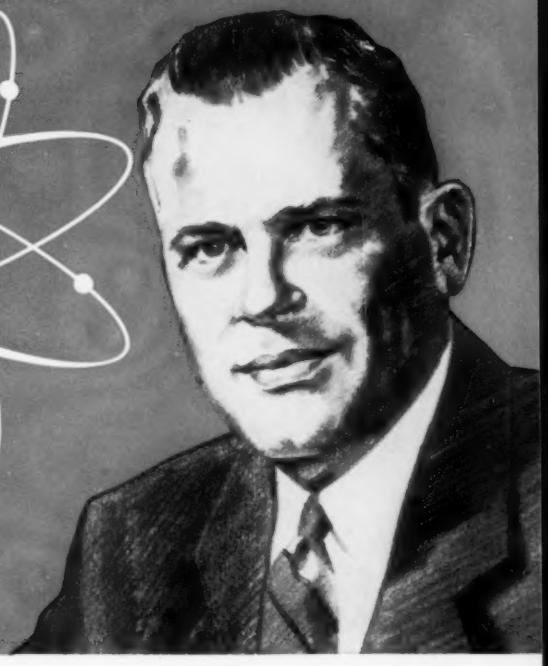
GENERAL ELECTRIC

CARBOLOY® CEMENTED CARBIDES • MAN-MADE DIAMONDS • MAGNETIC MATERIALS • THERMISTORS • THYRITE® • VACUUM-MELTED ALLOYS

OBSOLESCENCE

has broader meaning in the Atomic age





By L. A. MYHRE
Vice-President-Operations
WESTERN GEAR CORPORATION

Western Gear Corporation is ever mindful of the necessity for the replacement of obsolete machine tools.

In this Atomatic Age the phrase "obsolete machine tools" has a broader meaning than a few years ago. In one instance the old machine is obsolete due to the inability to produce parts economically. The economy of this replacement can readily be ascertained by use of the MAPI formula.

In other cases the machine which may be comparatively new is obsolete due to the inability to produce parts to today's exacting accuracy requirements for propulsion, ground control and guidance systems in the missile field. In this case the usual formulas cannot be applied. The only decision to be made is: Shall the necessary equipment be obtained that we may continue our growth, or, withdraw from the field?

Our practice at Western Gear is, each of our six divisions through their managers submit their requests for machine tools. They are reviewed by a management group and the necessity and priority established in accordance with the following objectives:

1. Economy (using MAPI formula and variations thereof).

2. Is it necessary to meet the more demanding tolerances of the "new age" in machinery concepts?

3. Will it place us in the position of being the leader in our field?

In fulfilling these objectives, we have found it necessary to spend several times our depreciation allowance for new facilities each year.

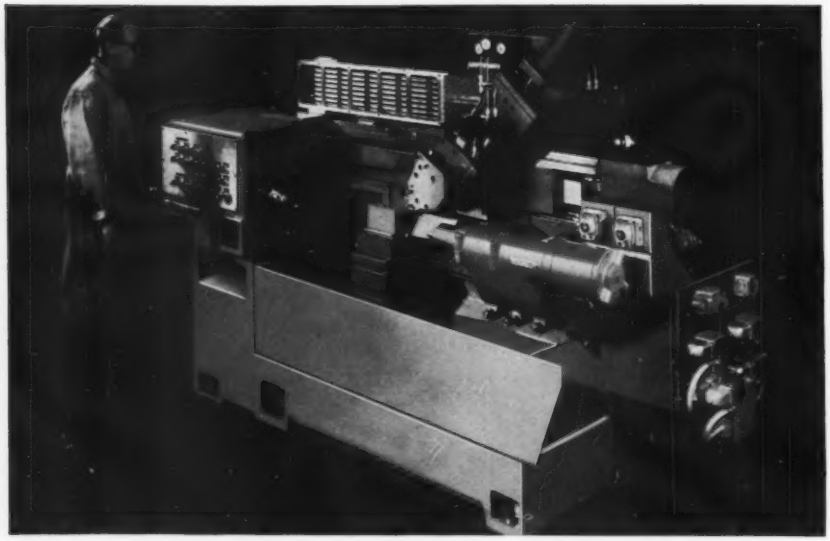
Keep gathering metal working production ideas . . . be well informed when you replace machinery . . .

Rockford Insert Group . . .

February, 1961

SUNDSTRAND "Engineered Production" METHODS

practical ideas for men who are responsible for manufacturing quality, quantity, and profit



Part — Clutch Shaft, #1345 Steel, 2-7/8" x 18" long.
Changeover time from Op. -1 to Op. -2 is less than 3 min.

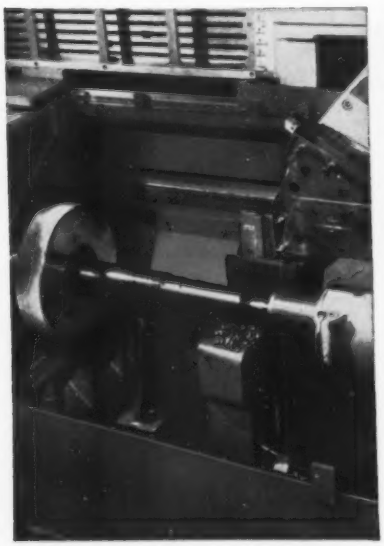
Op. 1 — Rough and finish turn large end. Time 1.125 min.

Op. 2 — Rough and finish turn opposite end and roll thread. Time 2.536 min.

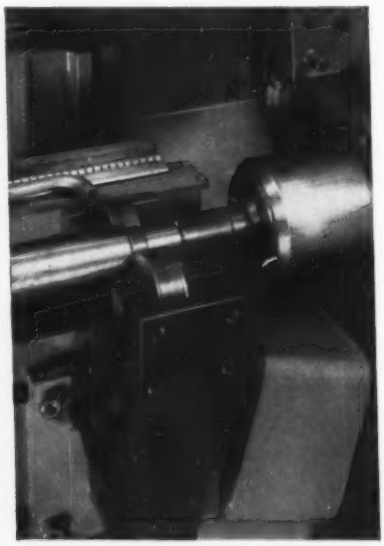
TURNING and THREAD ROLLING

Sundstrand multicycle tracer lathe combines automatic operations on clutch shafts to minimize machining time and handling

Machining costs on many parts requiring turning and related operations can be substantially reduced through use of Sundstrand multicycle hydraulic tracer lathes. The clutch shaft illustrated is a good example. Rough and finish turning and thread rolling all are performed automatically on a Model 14T machine.



During turning operations the thread rolls are protected against chips by a guard.



The thread roll guard automatically moves aside as machine cycles for thread rolling operation.

A single fixed-position template is used. The ruffing tool on this lathe will take up to three cuts automatically, then the finishing tool indexes into position. Extreme accuracy is assured by this operating principle (on many types of parts the need for rough grinding operations is eliminated). Ease and speed of setup makes the machine practical for small as well as large production lots.

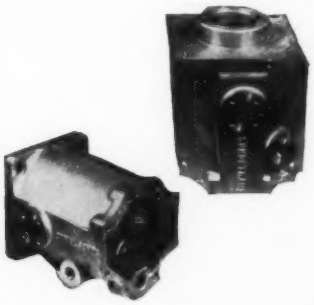
The Sundstrand Model 14T lathe is available in two standard sizes — 25 and 40 hp.

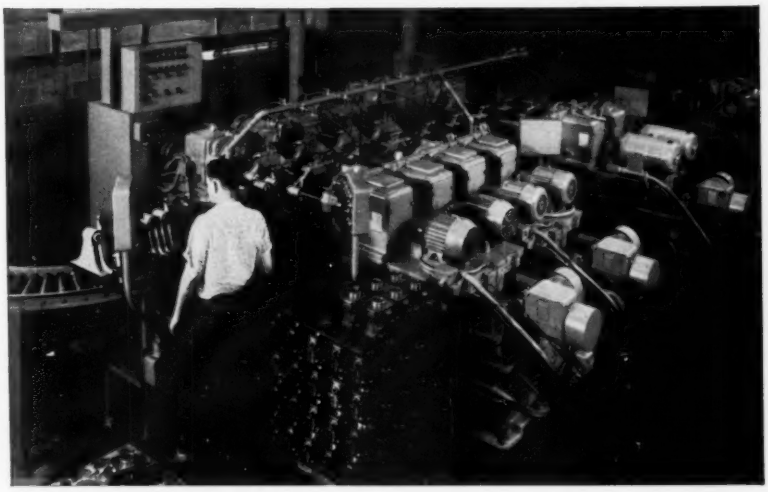
For details and specifications ask for Bulletin No. T-624.

CENTER OF MACHINE-TOOL EXCELLENCE **ROCKFORD, ILLINOIS, U.S.A.**

SHORT-RUN TRANSFER MACHINING

Lots as small as 500 to 1000 parts are practical because of quick change-over design





Quick-change tooling gives this Sundstrand 6-station pallet-type transfer line short-run efficiency. Low cost multiple-spindle heads and workholding pallets can be interchanged for a new job setup in less than 10 man-hours.

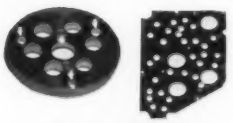
The machine illustrated is being used to process a family of five different hydraulic unit housings in lots as small as 500 to 1000 pieces. Operations include drilling, spotfacing, boring, and tapping to precision tolerances. Milling and boring heads can be added to or replaced in the line as required.

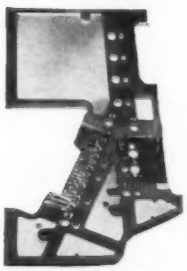
Quick change of heads and fixtures makes automation practical for small lots of similar parts.

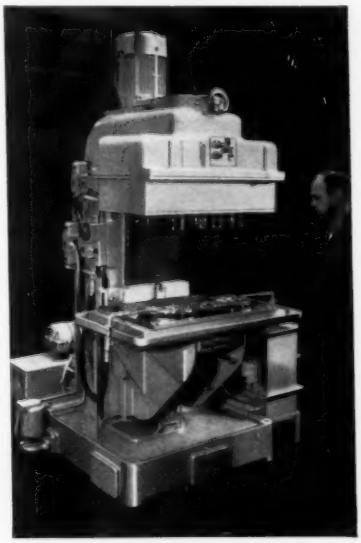
The development of practical short-run transfer machines is typical of the benefits of the Sundstrand "Engineered Production" approach to machining cost reduction. Details available upon request.

MULTIPLE-SPINDLE DRILLING

New machines provide high accuracy, fast change-over, and new economy even on moderate-sized production lots.







Sundstrand multiple-spindle precision drilling, boring, reaming, and tapping machines represent a new cost-cutting approach to machining large numbers of holes in relatively complex parts — even when production runs are moderate.

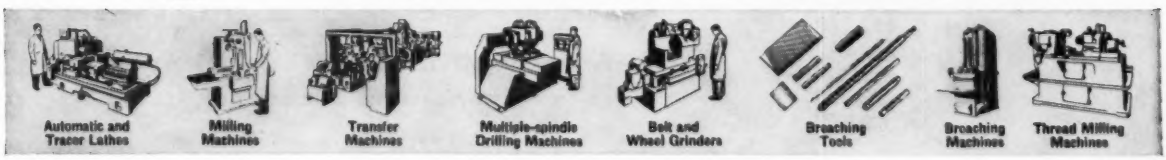
Key to the economy of the machines is the unique low-cost design of the heads which eliminates gearing and permits complete change-over in 15 to 20 minutes. Tolerances to .0002" for spatial relationship, shoulder depth, and hole size can be maintained, depending upon the nature of the work. Inspection requirements are minimized because of the accuracies built into the head, fixtures, and machine itself.

For more information, ask for Bulletin No. D-624.

SUNDSTRAND

SUNDSTRAND MACHINE TOOL

BELVIDERE, ILLINOIS • DIVISION OF SUNDSTRAND CORPORATION



CITY OF MACHINE-TOOL SPECIALISTS **ROCKFORD, ILLINOIS, U.S.A.**

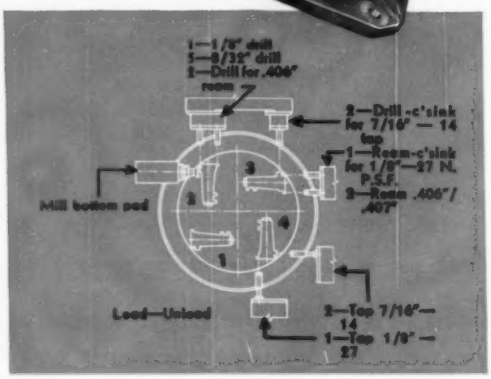
W. F. & JOHN BARNES

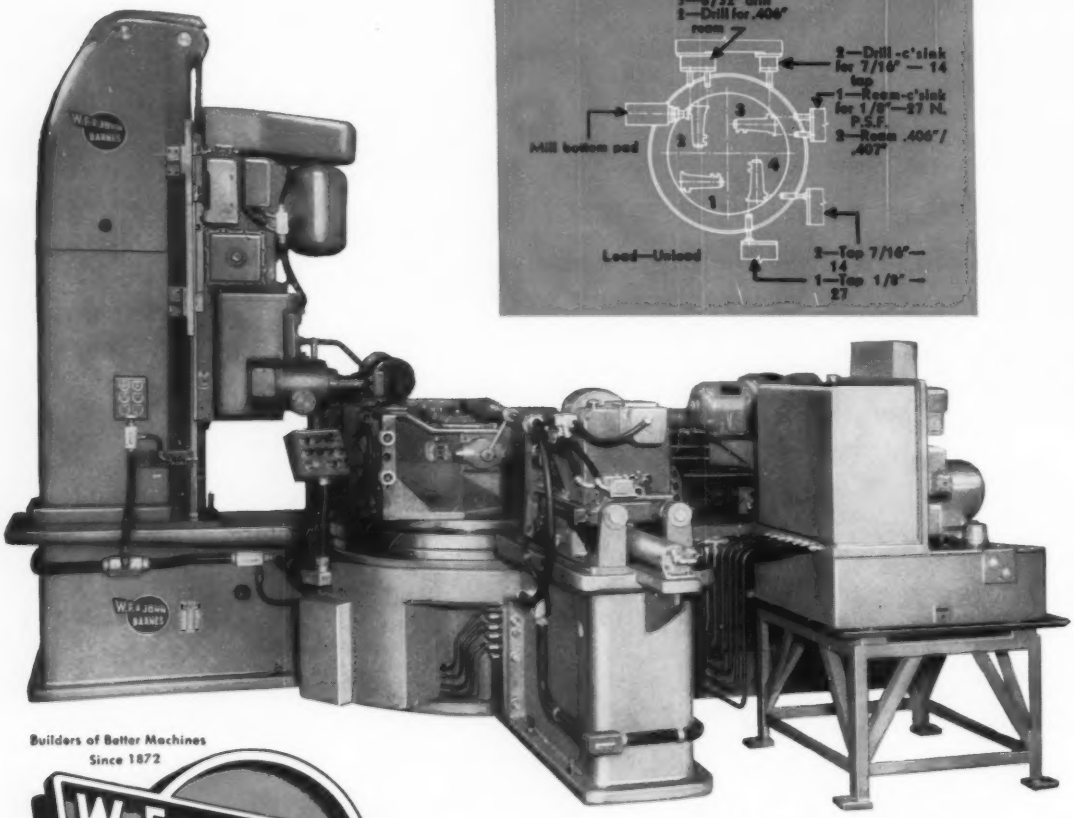
4 station special

HANDLES 17 MACHINING OPERATIONS, SAVES FLOOR SPACE

Here is another cost-cutting example of a special machine engineered by W. F. and John Barnes that provides both an efficient machining method and the means to save valuable floor space. A total of 17 operations on the cast aluminum transmission housing, illustrated at right, are performed at a gross production rate of 118 pieces per hour. Operator handles both loading and unloading while parts are processed at the three machining stations. A 48" diameter hydraulic table indexes the work from one station to another. Compactness of the machine's design conserves floor space, yet ample room is provided for easy accessibility to working heads.

Cast aluminum transmission housing

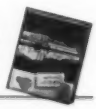




Builders of Better Machines Since 1872

W. F. & JOHN BARNES

ASK FOR AN ANALYSIS OF YOUR MACHINING METHODS — For assistance with machining problems ask a Barnes Engineer to work with you. Ask for a copy of "Coordinated Machine Engineering" — tells how Barnes 6-point machine building service saves time, eliminates divided responsibility.



W. F. & JOHN BARNES COMPANY

402 SOUTH WATER STREET • ROCKFORD, ILLINOIS

Multiple Spindle Drilling • Boring • Tapping Machines • Automatic Progress Thru Transfer-Type Machines

CENTER OF MACHINE-TOOL EXCELLENCE **ROCKFORD, ILLINOIS, U.S.A.**

MACHINES DESIGNED WITH THE FUTURE IN MIND

PRODUCTION MACHINERY
GREENLEE

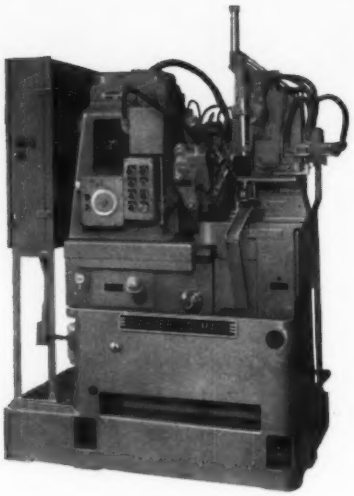
- Special Purpose Machines
- Transfer-Type Processing Machines
- Multiple-Spindle Drilling and Tapping Machines
- Six and Four-Spindle Automatic Bar Machines
- Die Casting Machines
- Trim Presses
- Woodworking Machines and Tools
- Hydraulic and Hand Tools

COOPERATIVE TEAMWORK MAKES THE DIFFERENCE

Through every phase of the construction of a Greenlee transfer machine, Greenlee engineers maintain a close contact with you, the customer. They are strong on the buyer's viewpoint . . . know what cost-conscious management wants. They stay on the job from the time of initial planning until your machine is operating at full efficiency. This last phase—the proving out period—is especially important. Greenlee men are extremely helpful in bringing your machine up to full production . . . training your operators to keep it producing profitably Call Greenlee. Let them show you how cooperative teamwork can benefit you.

GREENLEE BROS. & CO. 1943 MASON AVE. ROCKFORD, ILLINOIS

FOR PRODUCTION MACHINE TOOLS IT'S **ROCKFORD, ILLINOIS, U.S.A.**



Compact, high-speed hobbing machine combines many advanced principles of gear cutting . . . for manual operation or complete automation

Whether yours is a general-purpose gear shop or an automotive plant requiring high-volume production, Barber-Colman's new No. 4-6 vertical hobbing machine can give you total gear-cutting economy — low tool cost, faster cutting, increased machine utilization.

Here, in a compact vertical, is the perfect combination of high speed, rigidity, versatility, and automaticity . . . carefully built to Barber-Colman's recognized high standards of precision and extra quality.

High capacity in a versatile machine

Automatic cycling of the No. 4-6 includes carriage feed, retraction after the cut, and rapid carriage traverse to the starting position. Combined high speeds and minimum nonproductive time between cuts make decreased cycle times a practical reality. The machine is designed specifically to be tooled for automatic

MACHINES DESIGNED TO MEET YOUR NEEDS **ROCKFORD, ILLINOIS, U.S.A.**

High Speed, Versatile Hobbing

. . .with Barber-Colman's new No. 4-6 Vertical Hobbing Machine

loading. However, it is simple to set up and can be loaded manually when required.

As an example, the 12-14 pitch, nine-tooth automotive pinions (AISI 1024) shown here are hobbed at 240 per hour at 100% efficiency, using a 3″ diameter x 4″ long triple-thread hob. This job has a feed rate of .045″ per revolution, and a hob speed of 362 rpm (284 sfm). Total cycle time for each load of two pinions is 30 seconds.

The machine is automatically loaded . . . a shuttle places the blanks, two at a time, under the hydraulically actuated tailstock where they are locked in position against the serrated driver. After the cut, the shuttle unloads the finished work and picks up the next set of blanks.

The automatic hob-shifter is an integral part of the automatic cycle. It can be set to operate after each cycle, or after a certain number of gears has been cut. This assures high gear production and low hob cost.

Rugged design increases productivity

Vertical design of the No. 4-6 — with integral bed, spindle housing, and upright—provides extra rigidity and simplifies application of automatic tooling. The heavy vertical column rigidly supports all motions of the machine. Movements of the column in both directions are controlled by positive stops. Hydraulic pressure holds it firmly against a depth stop during the cut.

Close-couple design, with short shafts having high diameter-to-length ratios, minimizes vibration, even under the toughest conditions. Both the hob spindle and work spindle are mounted in precision tapered roller bearings.

These are reasons why the No. 4-6 can offer you maximum hob speed of 614 rpm and maximum feed of .150″ per work revolution.

For complete information on how you can gain total gear-cutting economy, contact your Barber-Colman representative or write the factory direct.

Barber-Colman Company

BARBER COLMAN

612 Loomis Street, Rockford, Illinois

FOR PRODUCTION MACHINE TOOLS IT'S **ROCKFORD, ILLINOIS, U.S.A.**

Surface grinding is more than cutting costs ...it's adding value

You might like to know what other plants are doing to reduce costs and improve quality.

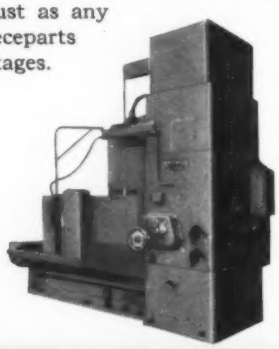
Right now, more people are buying surface grinders for *stock removal* than for any other reason. Plants which never before used grinders are putting Mattison machines on production work. A variety of flat machining jobs (not just hard materials) are being switched from milling machines, planers, and shapers. This is to take advantage of increased running time, high stock removal, and low wheel replacement costs. The aim is not "paper-clip" savings. Costs, in some cases, are being reduced 600% . . . and for work of higher quality.

Until you know how much ground finishes can add to the value of your product . . . and until you see assembly savings that can result from increased accuracy of mating or reference surfaces, it is difficult to appreciate the real advantages of surface grinding. Modern Mattison rotaries, with continuous downfeed, Quick-Tilt spindles, high horsepower, and high accuracy, are different from conventional machines. They should be evaluated objectively by methods engineers, just as any *new process*. We will sample grind your pieceparts at no charge to demonstrate specific advantages. Write or phone:

Mattison Machine Works
545 Blackhawk Park Avenue, Rockford, Ill.
Phone: WO 2-5521

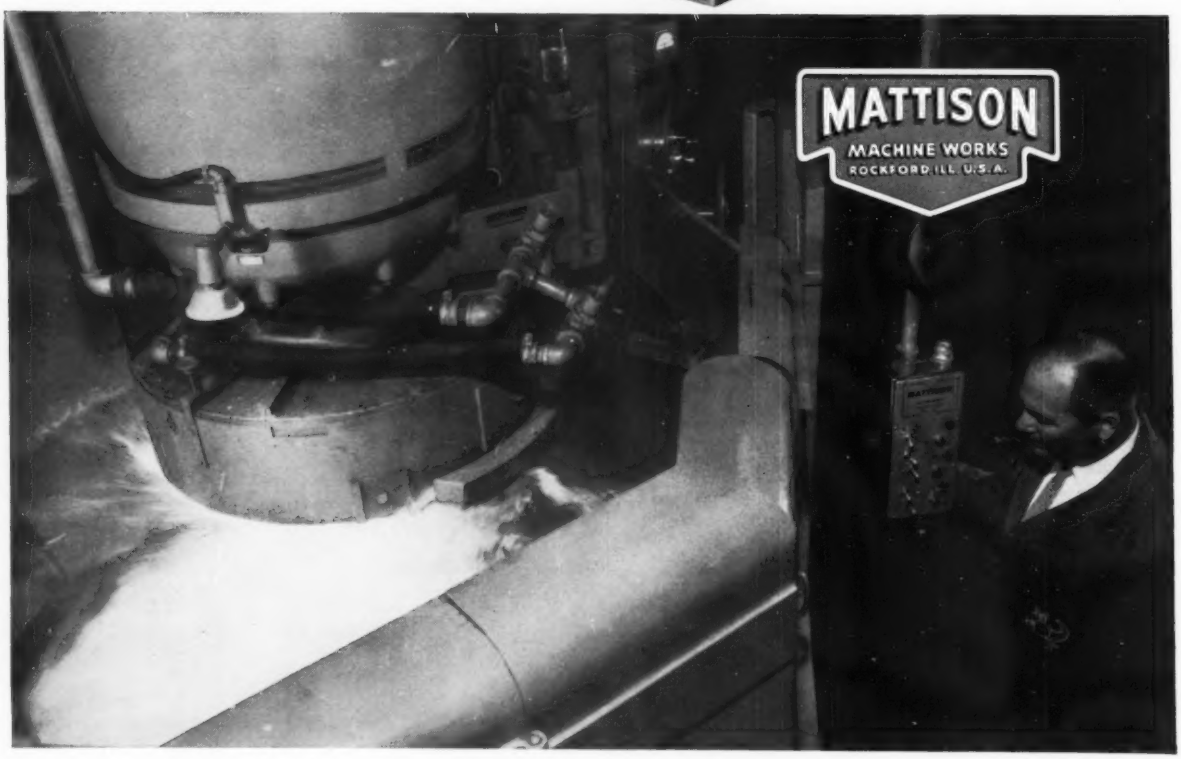
If it's a flat surface,

there's a Mattison to grind it!



Value added by surface grinding

- Easier, faster product assembly and servicing
- Longer service life, easier break-in, and reduced cost of product maintenance
- Higher product quality and increased salability
- Lower material and scrap costs
- Virtually no wheel-changing cost
- Low wheel inventory cost
- No "tool sharpening" cost
- Low wheel depreciation cost
- Low machining cost
- Faster loading and unloading
- Less checking and inspection



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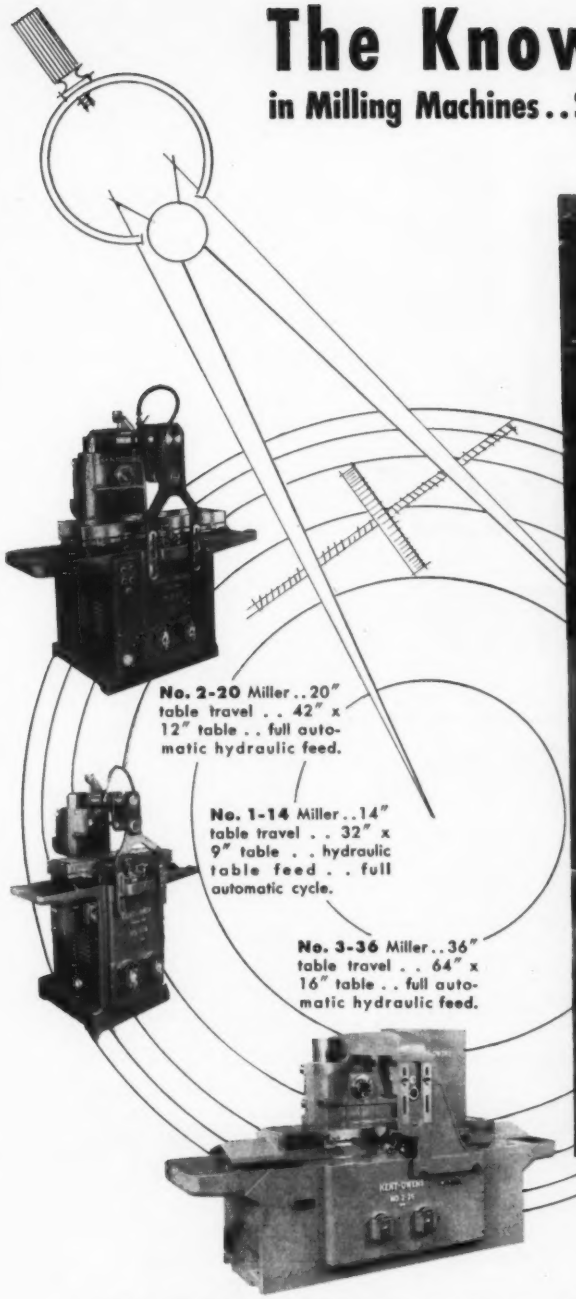

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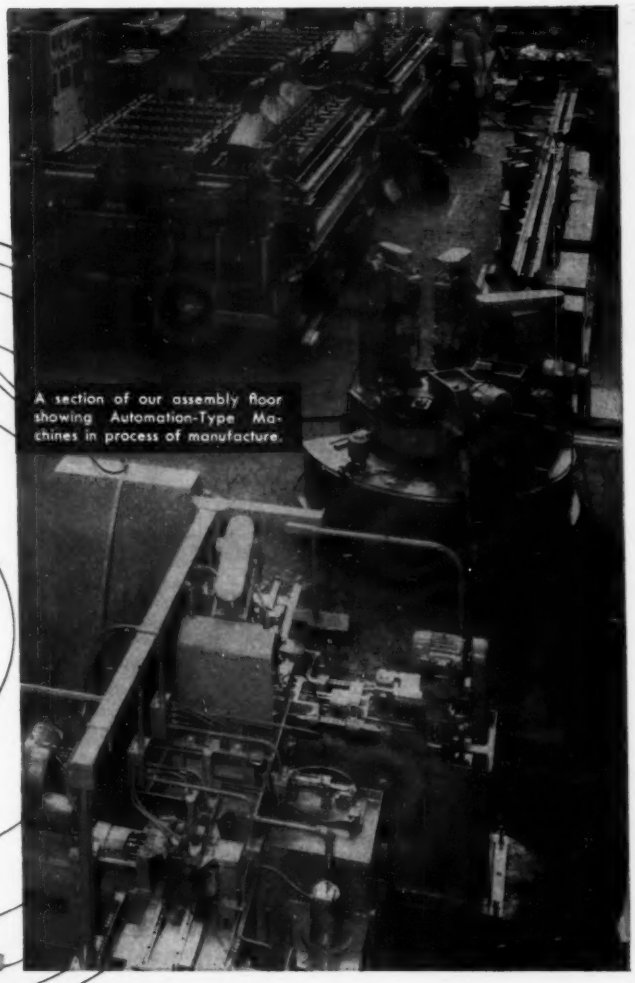

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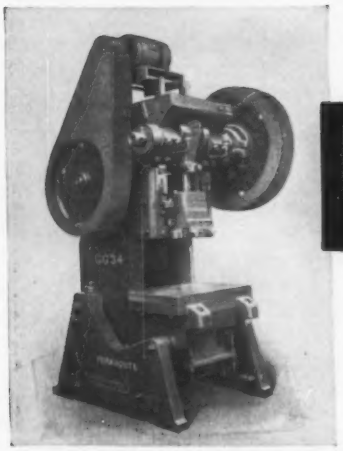

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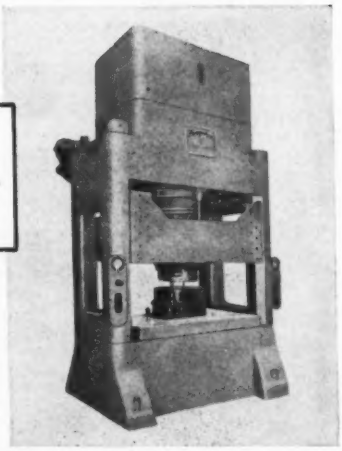

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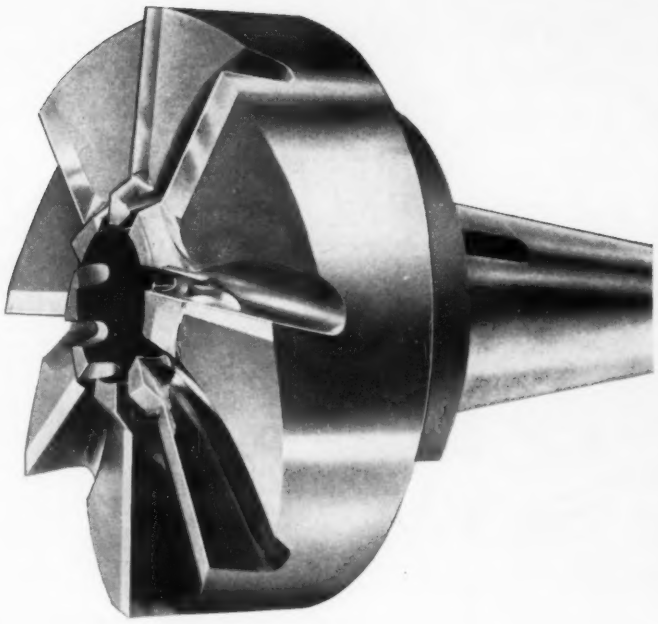

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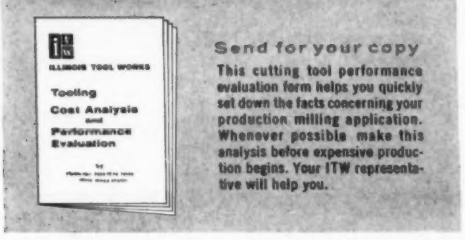

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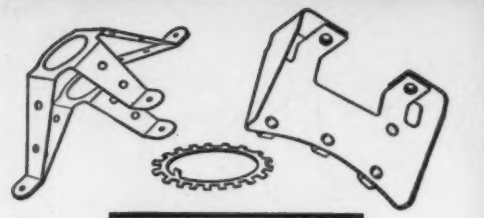

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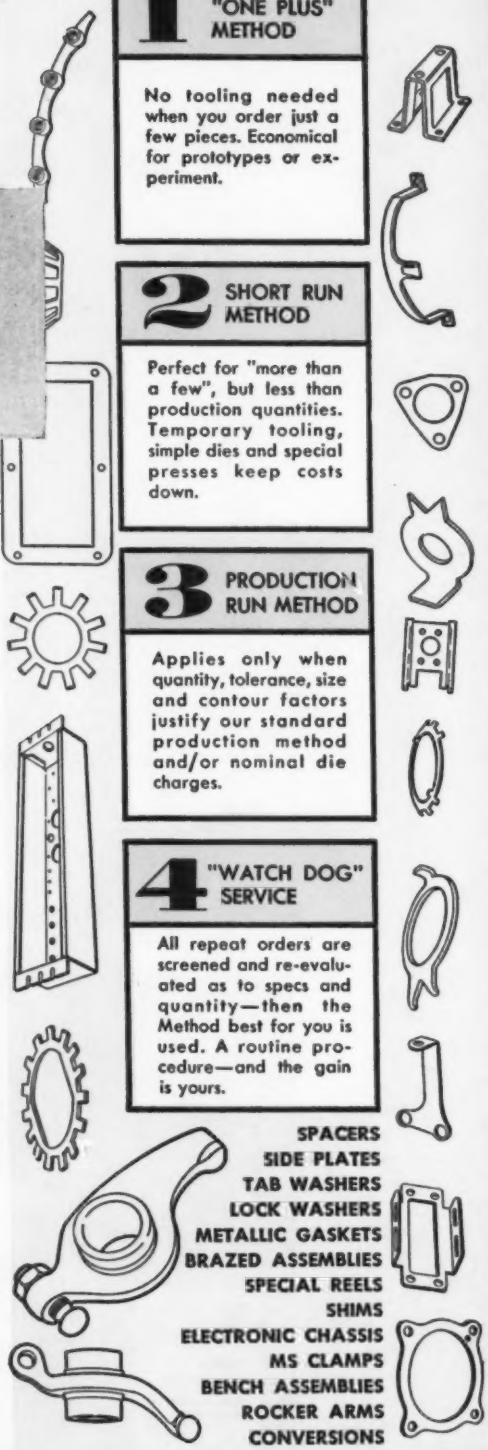

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- Machinery Groups Active
- Treasury Study Important
- Army Chief Concurs
- Labor's Role Cited
- New Face at BDSA

Keeping up with Washington

Loring F. Overman

IF THE COMING YEAR fails to witness a liberalization of depreciation procedures pertaining to plants and equipment, including machine tools, it will not be because the subject is not being spotlighted in Washington. Half a dozen or more organizations, both within and outside of Government, are involved. They point out that the future growth and prosperity of the country are more and more dependent upon efficient and economical production methods. The easing of depreciation allowances could provide the key to the installation of much-needed new equipment that would increase production rates.

Machinery Groups Active

Both the National Machine Tool Builders' Association and the Machinery and Allied Products Institute are taking an active part in making certain that Government is familiar with the problem. Ludlow King, executive vice-president of NMTBA, is optimistic concerning better days in 1961 for the machine tool industry. He has observed that in recent months the industry has not been able to report any great amount of progress, but that he "is hopeful that some of the plans now in the making will bear fruit in 1961."

MAPI is stepping up distribution in Washington key locations of its recently issued pamphlet, "Sixty Years of Business Capitalization," by George Terborgh, research director. The goal is to make certain that members of Congress and all others concerned are exposed to "a sound program of tax reform, particularly in the areas of the corporate rate and depreciation policy."

Treasury Study Important

Unquestionably the most important depreciation study was made by the U.S. Treasury Department. This official report will undoubtedly guide President Kennedy in actions promised several times during his campaign. At that time he said that "wherever we are certain that tax revision—including accelerated depreciation—will stimulate investment in new plant and equipment, without damage to our principles of equity, we will proceed with such revision."

Advance information concerning the report indicated that it dealt primarily with opinions of taxpayers on depreciation problems and their recommendations for reform of the depreciation system. Initial returns indicated widespread interest in methods providing greater flexibility, as well as in provisions for a taxpayer's choice of rates and methods for figuring depreciation.

Army Chief Concurs

Army's Chief of Research and Development, Lt. Gen. Arthur G. Trudeau, is speaking out in Washington in favor of liberalized depreciation procedures. Before a recent session of the National Security Industrial Association he said, "It is most essential that action be taken, and this may involve legislation, providing more rapid write-offs in order to modernize our plants and our machine tooling."

In addition, he said, "We are faced with new refinements in tolerances and operations involving great extremes of pressures and temperatures which were unknown before World War II."

Labor's Role Cited

While government agencies are being asked to encourage installation of new production equipment, certain business groups are pointing out that machinery alone is not the complete answer to the problem. Business analysts observe that corporation profits are only slightly above the 1947 level, despite the fact that more than $300,000,000,000 has been poured into new plants and equipment during the last thirteen years.

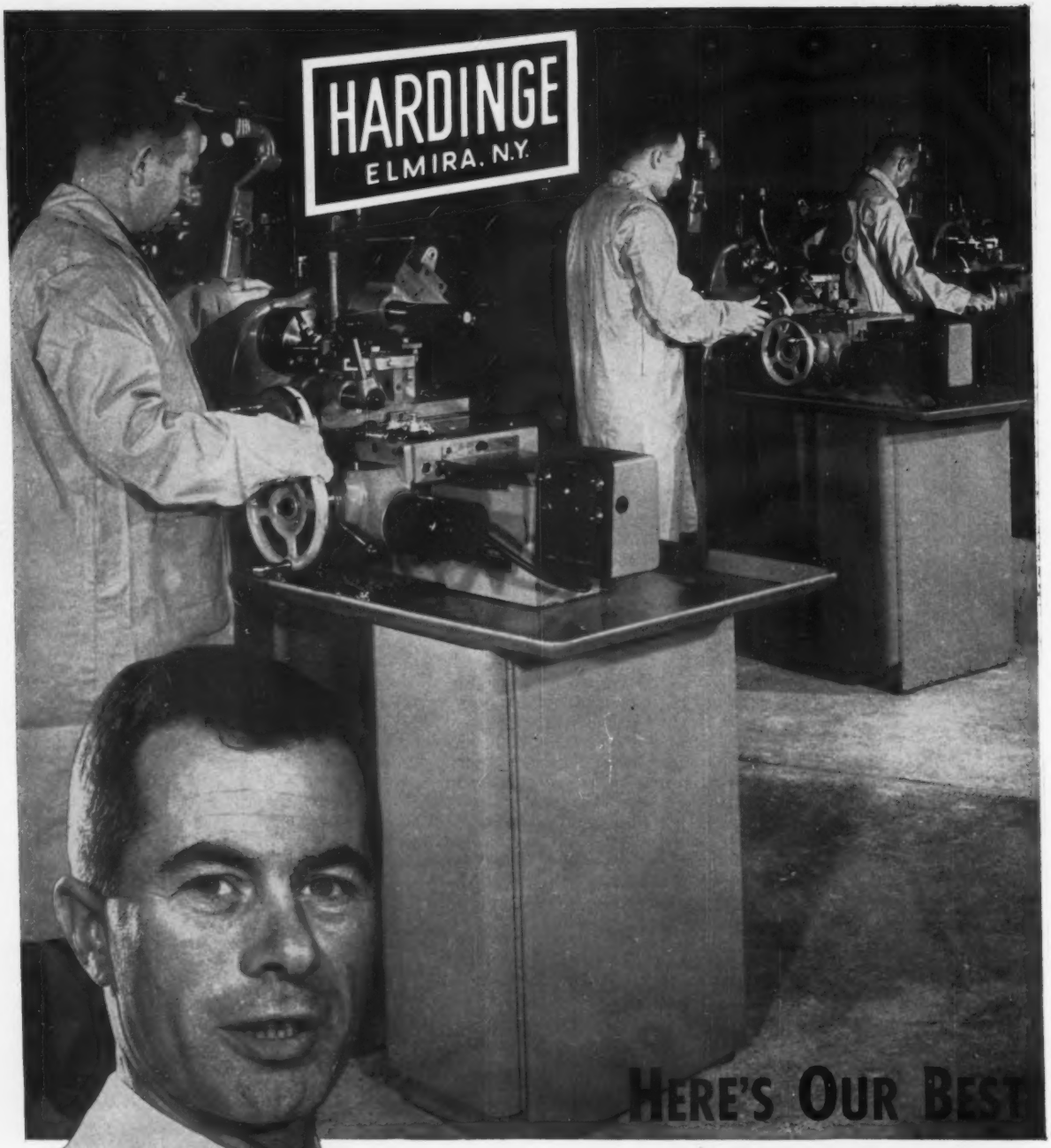
Proponents of the viewpoint that increased productivity depends as much upon men as upon machines are telling Washington: "Too long the benefits of increased production made possible by investment in new plant equipment have been appropriated by a relatively small segment of population represented by strong labor unions. The way to ease the squeeze is to seek national policies in collective bargaining and other areas, including work rules, which will enable employers to increase productivity and reduce costs."

New Face at BDSA

There is a new face in the mobilization and planning section of the Metalworking Equipment Division, Business and Defense Services Administration. With the promotion of Philip A. Bennett from acting head to director of the division, Barney Haffner moves into the section chief's spot. Early appointment of two civilian advisers to the division is expected.

The Commerce Department is eying the possibility that machine tool sales may rise by 4 to 6 per cent in 1961. After a slow first half-year, a pickup is anticipated about midyear, when general business conditions are expected to improve. Even greater improvement could be expected, observers believe, if Congress were to act early on proposals to liberalize tax depreciation allowances on machinery. Estimates of plant and equipment spending during 1961 point toward a $35,000,000,000 level.

Machinery shipments financed for a foreign country by the Export-Import bank should be shipped in nothing but U. S. Flag vessels, the chairman of the Senate Interstate and Foreign Commerce Committee has urged. The chairman, Senator Warren G. Magnuson (D-Wash.), lauded this viewpoint in a telegram to the Maritime Commission after it had denied a requested waiver of the U. S. flag shipping requirement.



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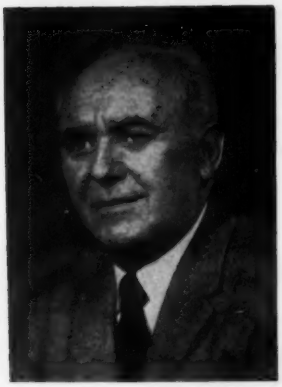

Management Problem Finally Becomes Labor's Too

TWO YEARS AGO, the United States produced one-half of the total world tonnage of extruded steel products—today, only 21 per cent. Even more startling is the fact that in 1960 Japanese companies accounted for 29 per cent of the total world output even though that output has risen 120 per cent since 1958. One year ago the Japanese were not even in production.

This picture is being repeated time and again in various fields of industry and in some cases is approaching such a critical stage as to question survival of some American businesses. In the watchmaking industry, for example, 70 per cent of the domestic market has been taken over by foreign manufacturers. In the radio field, Japan alone last year shipped over $62,000,000 worth into this country, mostly in the form of portable transistor sets. The importation of scissors and shears soared from 150,000 pairs annually in 1949 to over 8,000,000 pairs last year. The importation of general-purpose machine tools rose from 6.3 per cent in 1955 to 17.5 per cent in 1959, an increase of over 11 per cent in less than four years.

Obviously, such a situation calls for some drastic remedial measures. The reason for the loss of foreign and domestic markets by American manufacturers is due mainly to prices. Our prices are necessarily high because the average hour wage and fringe costs in manufacturing amount to $2.75. The nearest country to the United States in this respect is Sweden, with $1.08. Japan has the lowest labor costs, with only 55 cents per hour.

Up until now, foreign competition has been considered mainly a problem of business management. It is, therefore, most gratifying to learn that labor has become concerned over imports from abroad. At a recent meeting of the International Confederation of Free Trade Unions, American labor spokesmen gave notice that international trade competition based on low wages must be controlled. The Confederation includes the labor organizations of Europe, Australia, Asia, Africa, and North and South America.

Walter Reuther pointed out at the meeting that ever since World War II American labor has supported freer international trade as one way of strengthening the free world. He is reported as having said: "But we must understand that good will and noble sentiments are an inadequate answer to a worker losing his job because another worker is making the same product with the same tools but getting half the wage of the American worker.

"Pressure is building up in America which will lead to economic isolationism and be a blow to the free world. Economic isolationism may become necessary as a matter of survival and that would fragmentize the free world's economy, and the free world can't survive that way." The UAW leader pointed out that the same technology is being used by industrial countries throughout the world.

At long last, here is a problem on whose solution both management and labor could collaborate. Such action might start a new and welcome era in management-labor relations.

Charles O. Herb

EDITOR

How Ryerson gives you EXTRA VALUE IN SHEET STEEL

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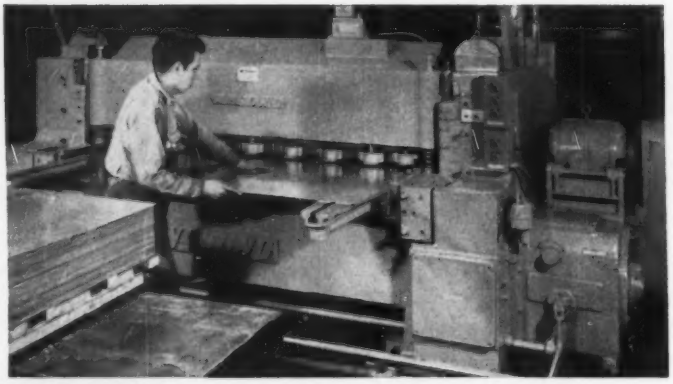

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Machinery
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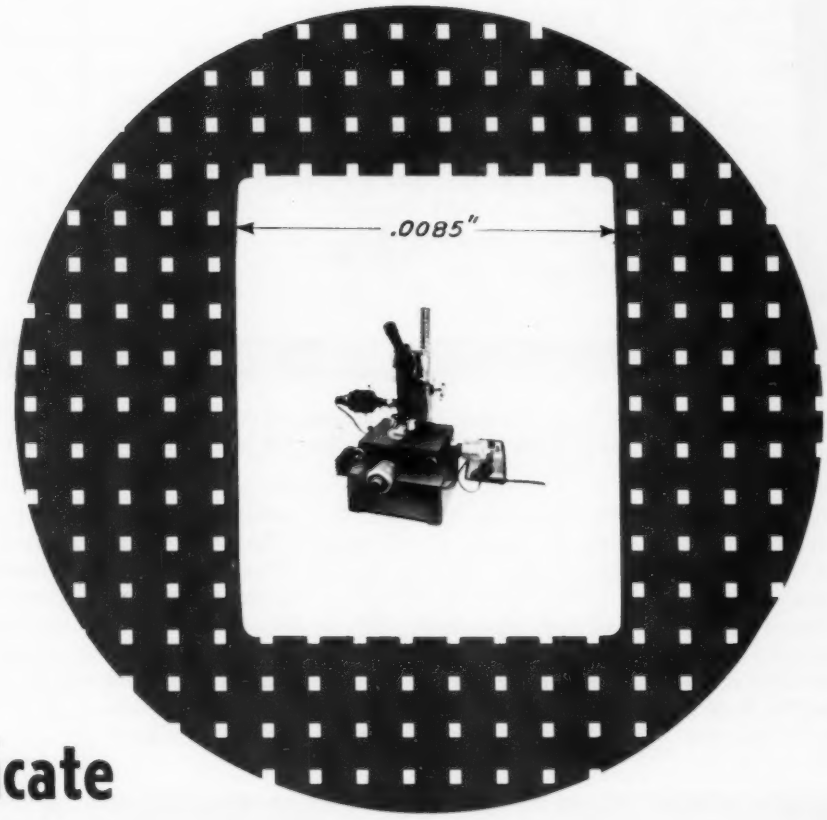
February 1961



Intricate thin-gage "stampings" made without dies

An article telling how a photoengraver has turned to work ordinarily considered within the province of metalworking

EDGAR ALTHOLZ

USING THE BASIC TOOLS and the empirical knowledge of the photoengraver, the Beck Engraving Co., Philadelphia, Pa., through its subsidiary, the Chemical Micro Milling Co., has developed processes for making a multitude of small parts such as are used for components of computers, missile guidance systems, and other electronic apparatus. The camera has been substituted for the diemaker, and the etchant tank for the punch press.

In contrast to the long lead time and the expense involved where a die has to be designed and constructed, it is possible to deliver finished

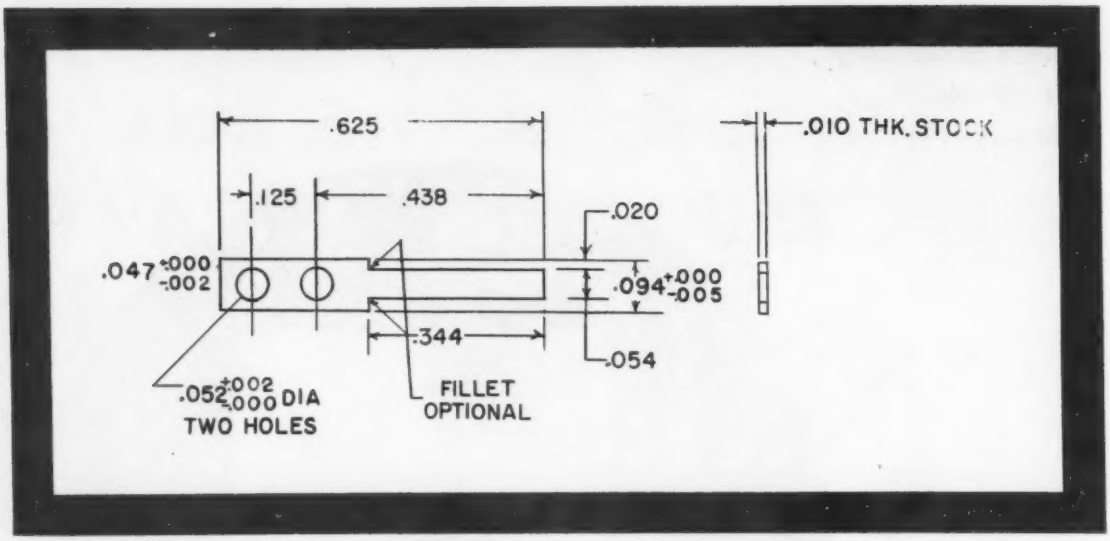


Fig. 1. From this engineering drawing of the part, the draftsman estimates the magnification needed to produce the parts within specified tolerances.

parts within hours after an order has been received. What is more, the process leaves the work flat, unstressed, and burr-free, requiring no secondary operations.

Small parts are produced not singly, but in multiples limited in number only by the size of the work relative to the capacity of the camera and the width of the metal strip. Without dies, there is no factor of die wear to consider, and the millionth part produced has the identical precision of the first part produced.

An intricate configuration takes no longer to make than a simple one, once an enlargement of the customer's drawing has been completed. And because the art work is greatly enlarged (up to 1000×), drawing errors are minimized to a point where tolerances on the finished parts can be held to ±0.0005 inch.

Fig. 2. The number of camera reductions involved determines whether the enlargement should be made positive or negative.

Fig. 3. First reduction from negative enlargement yields this positive.

Even more significant than the economy of eliminating conventional tooling costs is the impact that the process seems destined to exert on the burgeoning era of miniaturization. For the first time, many components for electronic apparatus are both possible and practical to manufacture to the scaled-down dimensions of optimum design. Already in production are intricate cams, nozzle filters, contact springs, vibrator springs, galvanometer mirror frames, vacuum-tube components, flapper valves, amplifier shields, transistor evaporator masks, and digital light-attenuation masks. Some of the masks are grids of complicated hole configurations so minute that they have to be viewed under a magnifying glass, and have center distances so closely spaced as to rule out conventional diemaking and stamping practices. One of the grids appears in the heading illustration. It consists of a pattern of rectangular holes only 0.0085 inch wide.

Typical of the items undergoing "fotochemical" fabrication is a part for an electrical-contact mechanism. It is made in two types of 0.010-inch thick nickel silver—half-hard and spring-tempered. As a first step, the customer's engineering drawing, Fig. 1, is examined to determine the scale of the initial art work. In this instance, it is decided (out of experience) that an enlargement of 50× is sufficient to compensate for any possible drawing error and still keep the finished part within the established tolerances.

Fig. 2 shows the draftsman at work on the enlargement. The drawing is made on Stabilene film, which is both permanent and highly moisture resistant. This particular rendition is made in reverse, as predetermined by the number of camera reductions involved. Since the contour of the part is simple, the draftsman is able to complete his work in well under an hour. (For a more complex shape, time can usually be saved by tracing on the film a blowup of the engineering drawing, assuming, of course, that the latter is scaled accurately.)

In the first of two reductions on a Klimsch precision camera, a negative of the negative art work (that is, a positive) is made directly from the film, as can be seen in Fig. 3. A second reduction on the same camera then produces a negative which is the exact size of the finished part, and which, for all practical purposes, may be considered the "end tooling" of the process.

It is then a matter of sound economics to turn out as many parts simultaneously as is possible, as governed by the capacity of the etching-room equipment, the width of the stock strip from which the parts are made, and the required production quantities. As a result of weighing these factors in this instance, 360 work-pieces are etched at the same time.

The next step, therefore, consists of making 360 reproductions of the "end tooling" on a single sheet of film. This is done on the Rutherford step-and-repeat camera seen in Fig. 4. First, the image is repeated horizontally to form a row of

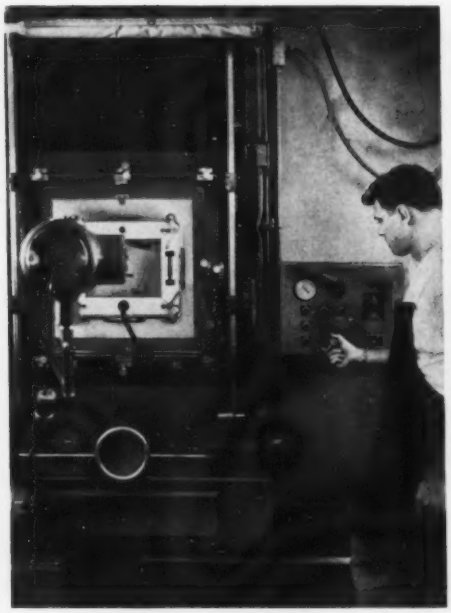


Fig. 4. End tooling of part is reproduced 360 times by this step-and-repeat camera.

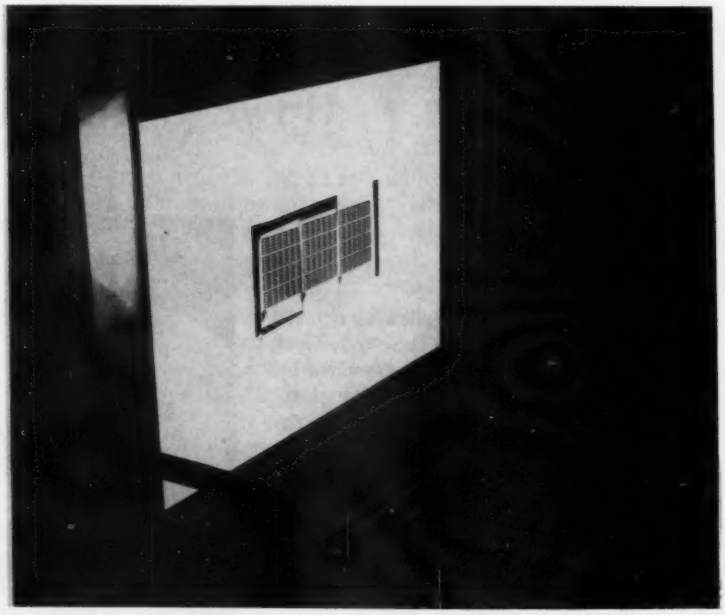


Fig. 5. The plate and superimposed printing master are held in a vacuum frame before carbon-arc lamps.

five. Then the row is repeated vertically until a rectangle of six rows is obtained. The thirty images are next repeated as a unit until twelve such rectangles cover the film, now referred to as the printing master.

The nickel-silver material, furnished in plates sheared to the size of the printing master, must now be cleaned thoroughly. This is done by scrubbing the plates with a rotating brush through which water flows. Any dirt on the surface acts as an insulator and prevents proper chemical attack. A phosphoric-acid treatment, performed next, roughens the surface sufficiently to form a good base for the subsequent coating operation.

Kodak metal-etch resist (KMER) is applied to the plates in a room illuminated by gold fluorescent tubes. The resist, a thick liquid, is poured on. Drying takes about a half-hour. To obtain a uniform coating, the plates are placed in a whirler for the drying interval.

To expose the image, the printing master is placed on top of the plate, and both are positioned in a vacuum frame. Flatness is obtained by evacuating the frame to 25 to 35 inches of mercury. Then it is tilted vertically, Fig. 5, before carbon-arc lamps for four to eight minutes. When the plate is removed from the frame, it is immersed in a developer for two to three minutes. A water spray flushes away the developer and dissolved resist.

Actual etching—the chemical milling—is done in a ferric-chloride bath. Immersion time is approximately four minutes. Fig. 6 shows the machine operator inspecting an etched plate. The final step consists of removing the resist. The plate is soaked in xylene to swell the resist, which then can be scrubbed off with a bristle brush.

Each plate goes through a 100 per cent inspection on an optical comparator, Fig. 7. As can be seen in the illustration, there is a thin ribbing of metal holding each row of tabs together. The rib pattern was added to the end tooling prior to the step-and-repeat camera operation. Leaving the parts attached to the plate simplifies their removal from the etching machine and final processing, inspection, and shipping as well. At the customer's plant, the ribs are snipped off before using the parts in assemblies.

Chemical Micro Milling's fabrication of other parts proceeds similarly, with whatever modifications in cycle times, cleaning agents, developers, and etchants are found from experimentation to be necessary. Results have been excellent in copper and aluminum material, both pure and alloyed. Ferrous metals, from pure iron to medium-carbon steel, are handled successfully; good results are also obtained with high-carbon and alloy steels, but at somewhat greater cost.

Generally, a material thickness of 0.020 inch is considered the maximum practical, unless edge taper is not a factor. Above 0.008 inch, edge taper is frequently balanced out by etching both sides of the material simultaneously. In those instances, both sides are coated with the resist, exposed, and developed.

Fig. 6. Following a four-minute etching cycle (chemical milling), the plate is examined by means of a magnifying glass.

Fig. 7. Final processing step is this 100 per cent inspection of the parts on an optical comparator.

Diamonds in the Swarf

Do you grind carbide with diamond wheels? The chances are that if you do and are not saving your tank sludge, you are overlooking a diamond mine right in your own shop. Even if you wear out only a dozen diamond wheels a year, the swarf may be worth four or five dollars a pound. Save up your sludge until you have at least 50 pounds (dry) before sending it away for reclamation.

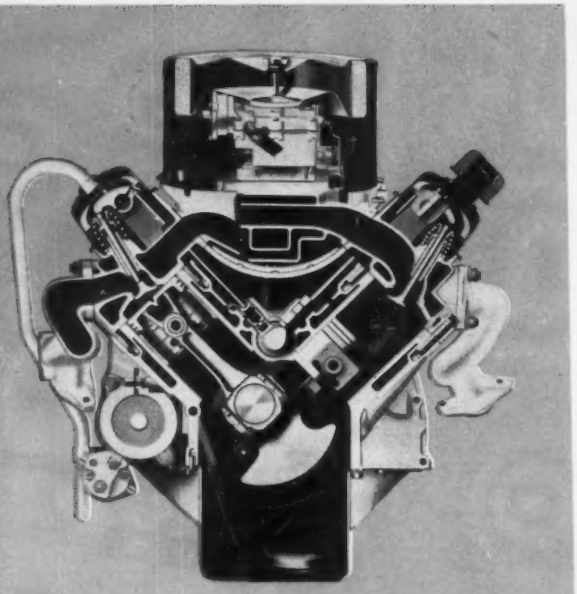
If you are a big user, send in your swarf every three months. Send only the swarf from your coolant reservoir. Don't take a chance of ruining the lot by dumping in your floor sweepings. Keep your diamond-wheel exhaust separate from other grinder systems so as not to dilute or contaminate the diamond swarf excessively.

When you collect swarf from machine coolant reservoirs, remember to give the diamond fines a chance to settle. Diamond dust weighs only a third as much as carbide; therefore, let the tank stand quietly for an hour or so before you pump off the fluid. Otherwise, you may accidentally lose valuable diamond.

When sending swarf back to the factory for reclamation, it does not have to be completely dry. But if it is damp, the containers must be leakproof drums or cans. The containers should be of a design that will not permit the build-up of pressure. If you are wondering whether your diamond grinding swarf is worth reclaiming, send a 5-pound sample, or the entire lot, to your grinding-wheel manufacturer. But do not be too pleased if you find your swarf has high reclamation value. It may indicate that you are grinding inefficiently. Remember that you save more by proper use of diamond wheels than by reclaiming swarf.

Abstracted from "Grits & Grinds," published by the Norton Co., Worcester 6, Mass.

All-new engine for the F-85 points up the current trend of automakers in this country — a drift toward the use of aluminum wherever practicable. With this change came the manufacturing difficulties that might well be expected. However, these have now been surmounted and a new line for machining aluminum heads is functioning without a hitch.



Oldsmobile turns to Aluminum

A U-SHAPED LINE, 400 feet long, in Lansing, Mich., represents two major steps undertaken by the Oldsmobile Division of General Motors Corporation. First, it symbolizes the division's first entry into the low-price field. Second, it is evidence of Oldsmobile's first attempt at mass-producing a water-cooled, aluminum V-8 engine. (More specifically, it is GMC's first attempt, as the same basic engine, a product of more than three years of intensive development work, is also used in the Buick Special and is an option in the Pontiac Tempest.)

Powering the six-passenger F-85, the 215-cubic-inch displacement engine (heading illustration) generates 155 brake horsepower at 4800 rpm and has an 8.75-to-1 compression ratio. Its block is shared with Buick's Fireball V-8 and is, in fact, being turned out on the Buick lines in Flint. Although made of aluminum, the block has cast-iron cylinder sleeves molded in place. Tipping the scales with a basic weight of 350 pounds, this new small V-8 has one of the highest power-to-weight ratios in the industry.

Differences in valve mechanism between the Rockette and Fireball engines dictated that Oldsmobile manufacture its own cylinder heads. This compelled the division to install a new line in its plant No. 3 to process them. Each section of the head line is new except for an eleven-station W. F. & John Barnes machine (for finishing valve seats and guides) that has been rebuilt by F. Jos. Lamb.

Planning this line was not as routine a matter as it might have been had the heads been of more-familiar cast iron. Speeds, feeds, and tool geometry were among the more obvious items up for analysis. But one of the biggest "extras" to be allowed for was a complete coolant supply and handling system.

Thanks to the high metal-removal rates possible when working aluminum, mountains of light, flaky chips tend to pile up on the transfer rails and cling to the machine heads and to the castings. To cope with this hazard to accurate positioning and machining, coolant (equal quantities of WA-159 and C-60 mixed one part with

fourteen parts of water) floods the automated line at a flow rate of 3000 gallons per minute. Only part of this flow (approximately one-third) is necessary for coolant purposes, the rest merely clears the work-pieces and work area of chips.

Coolant is serviced in two below-floor-level tanks at the head of the line. Chips and coolant flow into the first, or settling, tank, which has a capacity of 35,000 gallons. When most of the chips have settled out, the fluid is pumped through a Hydromation unit where remaining chips and sludge are trapped by large rolls of filter cloth. From here the clean coolant is delivered to a 6000-gallon capacity tank for redistribution to the line.

Milling Plus High Cutting Rates

Cylinder heads are semipermanent-mold castings of 356-T5 aluminum. That is, they are basically permanent-mold castings but make use of conventional sand cores.

Leading off the automated line is a seven-station Snyder transfer machine on which five main surfaces are milled. At the first station, Fig. 1, the cover face and both the exhaust and the bolt bosses are finished. These surfaces are denoted by heavy lines at A, Fig. 2. Three inserted-tooth (Grade C-2 carbide) cutters are used—one vertical (5-inch diameter, ten teeth), one horizontal (3.625-inch diameter, four teeth), and one set off at an angle of 48 degrees (4-inch diameter, eight teeth).

Cutting speed for all three tools is 2075 sfpm with a feed rate of 159 ipm. As the casting approaches the cutters it, and the spindles, advance a short distance together. Then the casting halts, is locked in place, and the spindle heads reverse their direction of movement at the selected feed.

An idle station follows, after which the heads are turned 90 degrees to bring the joint face to the left and the intake manifold face to the top. At another station in this first section the main joint surface and the intake manifold faces (B, Fig. 2) are milled. For the larger surface an 8-inch diameter cutter is used at 2000 sfpm. A 4-inch diameter cutter machines the smaller faces at 2075 sfpm. Both feed at 159 ipm.

Next in the line is a thirteen-station Footburt transfer machine where fifty holes are processed in the cylinder head. Every second station is idle, leaving six where work is done.

At the first work position (Station 2) a pair of 8-inch diameter Ingersoll Shear Clear face mills

for Rockette V-8

RAYMOND H. SPIOTTA
Associate Editor

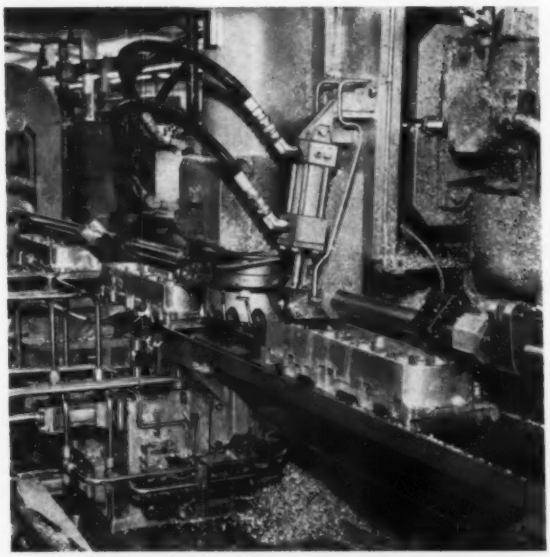


Fig. 1. First cuts are taken on cylinder-head casting in this seven-station transfer machine. Three cutters mill the cover face and exhaust and bolt bosses.

Fig. 2. Areas milled in the first section of the automated line. Surfaces indicated by heavy lines at A are machined at Station 1; those indicated at B, Station 6.

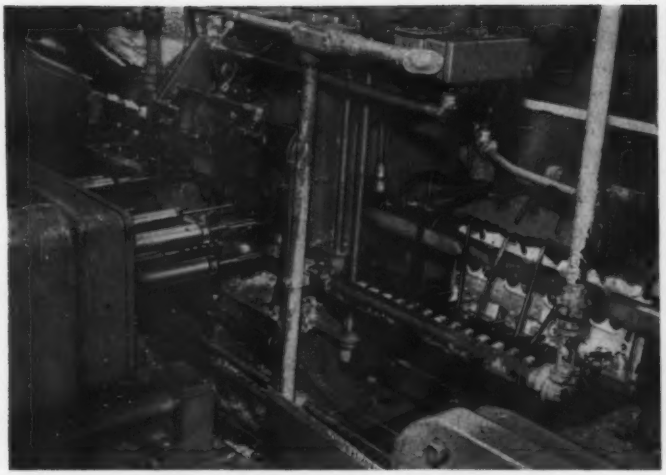


Fig. 3. Four bolt holes are drilled and six reamed (left) in the joint-face area. At idle station (right), casting will be flushed with coolant to remove aluminum chips.

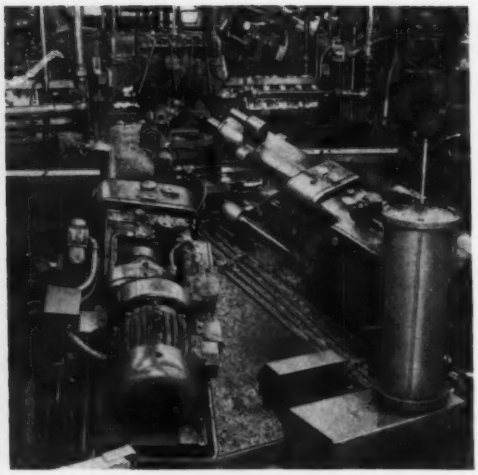


Fig. 4. Drilling four spark-plug holes in head at compound angles. Inclined positions provide clearance between plugs and exhaust stacks.

are advanced from the left-hand spindle head to straddle-mill six end pads. They are fed at 90 ipm while turning at 1040 sfpm. At the same time, the opposite spindle head drills thirteen holes, then countersinks two of them. In most instances of drilling and countersinking, subland drills are used. To permit rapid chip evacuation from the holes, drills of high-spiral design have proved most satisfactory. They have polished flutes with large radii. Margins are narrow—approximately 0.015 inch—to prevent loading and the resulting oversize holes.

More subland drills are brought into play at the next position (Station 4), where the left-hand spindle head drills and countersinks eight holes in the exhaust mounting bosses. From the right-hand side of this station ten tools are advanced (left, Fig. 3). They drill four bolt holes and ream six others that had been drilled in the previous step (four locating holes and two holes for doweling head to block). The casting shown on the transfer rails at the right is at the idle station between work stations No. 4 and 6. This is typical of each idle station, where numerous tubes are carefully positioned to direct a flood of coolant not only over the entire cylinder head, but also into the holes or against the areas just machined to flush out the aluminum chips. (In the interest of clarity, coolant flow has been shut off in each of the illustrations.)

After stopping at Station 6, where twenty-six holes are drilled and five countersunk, the castings arrive at Station 8. All four spark-plug holes are drilled from the right-hand side of the line, Fig. 4.

Spark plugs on the Rockette engine are angled into the head from two directions to provide clearance with the exhaust stacks. Therefore the drill heads, as shown, approach the work-piece accordingly. Each of the two heads is set at a compound angle—45 degrees up from the horizontal and 30 degrees to the left or right. Two spindles feed from each head, carrying combination tools for drilling 5/8-inch diameter holes and cutting 0.040-inch by 45-degree chamfers in the same pass (150 sfpm). At the same time, on the left-hand side of the line, fifteen holes are being tapped. These include eight exhaust mounting holes and five valve-cover mounting holes.

Moving on to Station 10, one pair of spark-plug holes is counterbored to 0.875-inch diameter, countersunk 0.594-inch diameter by 90 degrees, and reamed to 0.505-0.500 inch in diameter. All three steps are done by one special tool. While this is being done, four 0.250-inch diameter holes are drilled in the joint face.

Similar operations are performed at the following station, where the remaining pair of spark-plug holes is counterbored, countersunk, and reamed. From the rear, however, four taps feed out to cut the 14-mm spark-plug threads. Taps used on this transfer line are Threadwell high-spiral Turbo-Cut which have a 52-degree spiral angle, again for rapid chip removal.

Next in line is a second Footburt machine, this one with seventeen stations. Here, too, every

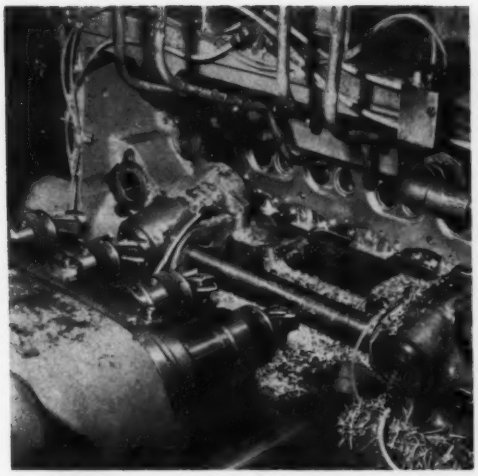


Fig. 5. Stub tools here machine four alternate valve-seat recesses. They are finish-bored, rough-counterbored, chamfered, and spot-faced.

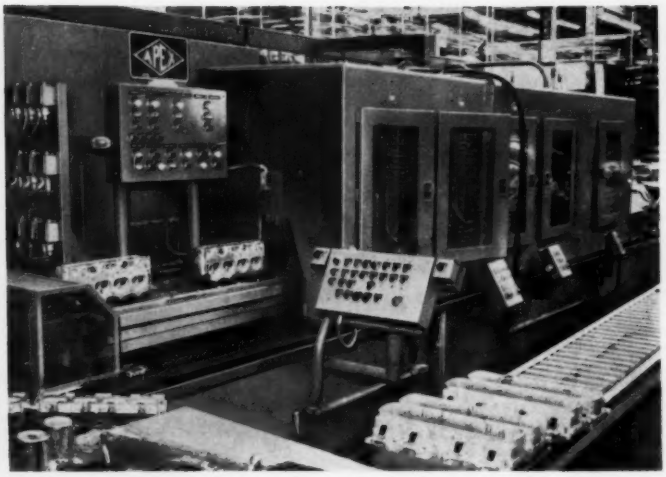


Fig. 6. Transfer type, ten-station impregnating machine for sealing those castings found to be leaky or porous. Sodium silicate is applied to defective chambers at a pressure of 100 psi.

second station is idle. When the casting enters this section it is tipped forward through an angle of 14 degrees to bring the valve-guide holes into a horizontal plane. In Station 2 the left-hand spindle head drills all eight valve-guide holes, while the opposite head, Fig. 5, finish-bores, rough-counterbores, chamfers, and spot-faces four alternate valve-seat recesses. Stub tools are used for machining the valve seats so that no support bushings are required.

These same cuts are taken on the remaining four valve-seat recesses by the right-hand head in Station 4. While this is being done, fourteen areas on two other faces of the casting are spot-faced.

Stations 6 and 8 perform identical operations, but on alternate holes. One spindle head at each stop trepans four valve-spring seats and semi-finish-bores (single-point tool) the guide holes. The other spindle head finishes the counterbores for the valve-seat inserts. Following up this sequence, all eight guide holes are finished-reamed at Station 10 to 0.656-0.657 inch. At Stations 12, 14, and 16, six holes are counterbored on the intake face, and two holes are drilled, countersunk, and tapped on one end face.

Cylinder Heads Checked for Air Leaks

Ending their trip down the first leg of the U-shaped line, the aluminum cylinder heads pass through a Centri-Spray washer, where all traces of coolant and loose metal particles are removed. Beginning the second leg of the line are two Beach units that air test the heads to determine the presence of either direct leakage or excessive porosity. All necessary passages are automatically sealed when the unit is actuated, and air is forced into the water jacket and the combustion chambers to a fixed pressure. If there is no noticeable drop in this pressure during a holding period of less than one-half minute, the casting is automatically stamped as being acceptable and continues along the line.

On the other hand, too rapid a decrease in the pressure of the trapped air signals unacceptable leakage or porosity. Offending cylinder heads are routed via a branch conveyor to the automatic ten-station Apex impregnating machine shown in Fig. 6. Here the defective chambers are sealed with sodium silicate under a pressure of 100 psi. The chambers then undergo a water flush, after which they are dried by an air blast. Further drying is allowed in room air for a period of sixteen hours before the castings are rechecked on the Beach units.

Cast-iron valve-seat inserts and valve guides are pressed into the aluminum heads in the seven-station Parker transfer machine shown in Fig. 7. Of the seven, four are working stations. One pair of valve seats and one pair of valve guides are installed at each of these positions, so that two cylinder heads are worked at the same time.

Valve seats feed from manually loaded magazines—such as the two indicated at A, Fig. 8—

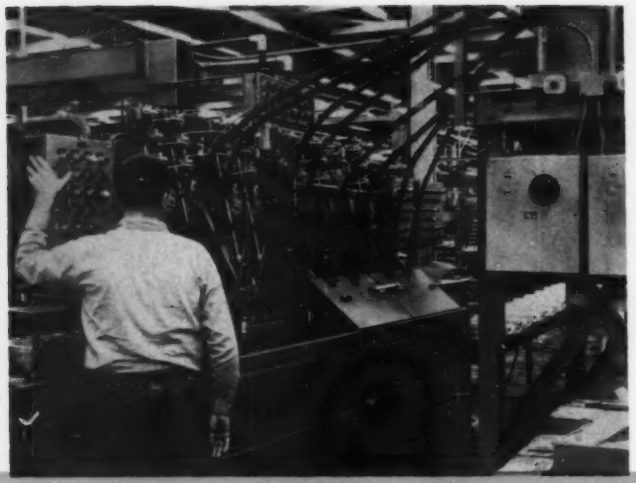
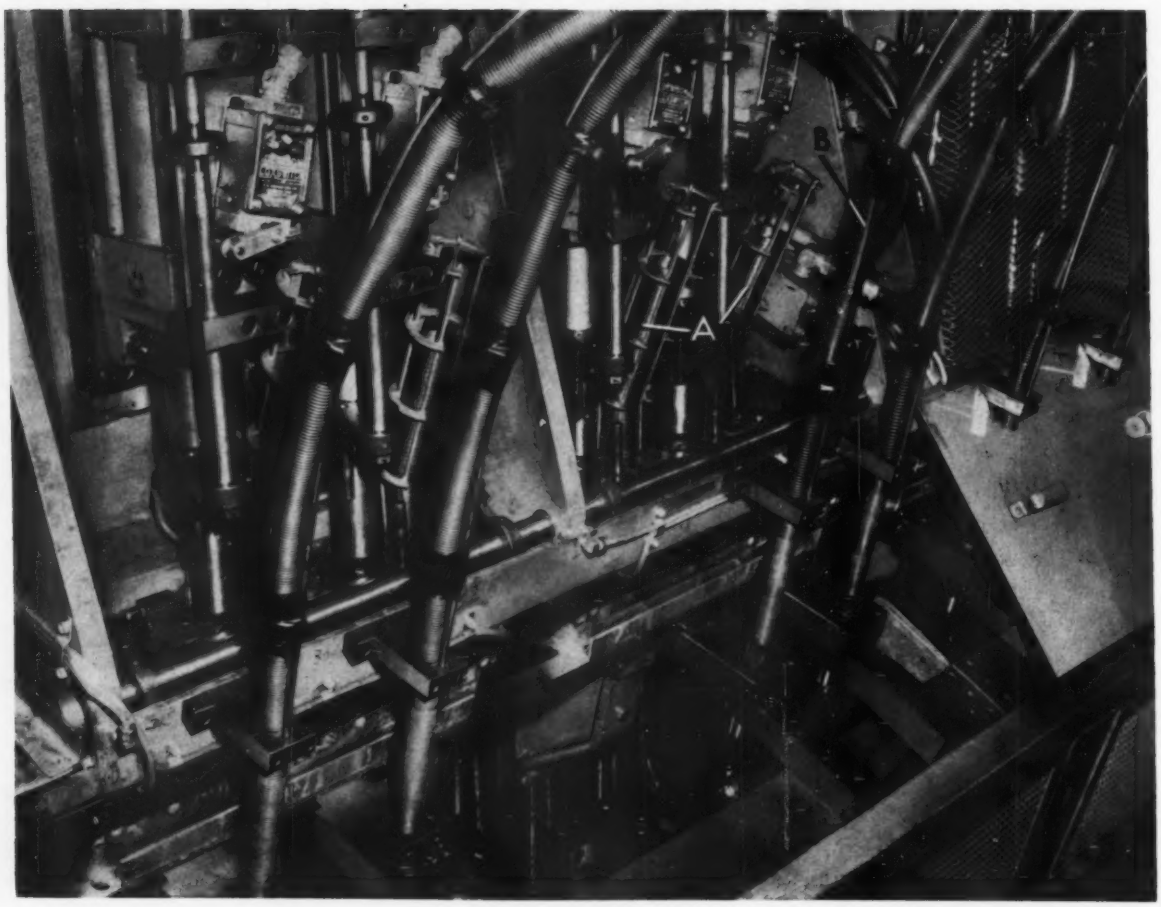


Fig. 7. Special seven-station assembly machine installs cast-iron valve-seat inserts and valve guides. Vibratory hoppers on platform (upper right) deliver valve guides.

Fig. 8. Valve guides arrive through flexible tubes (B) to position below casting. Seat inserts feed from magazines (A) to position above casting. Rams then drive inserts into head.



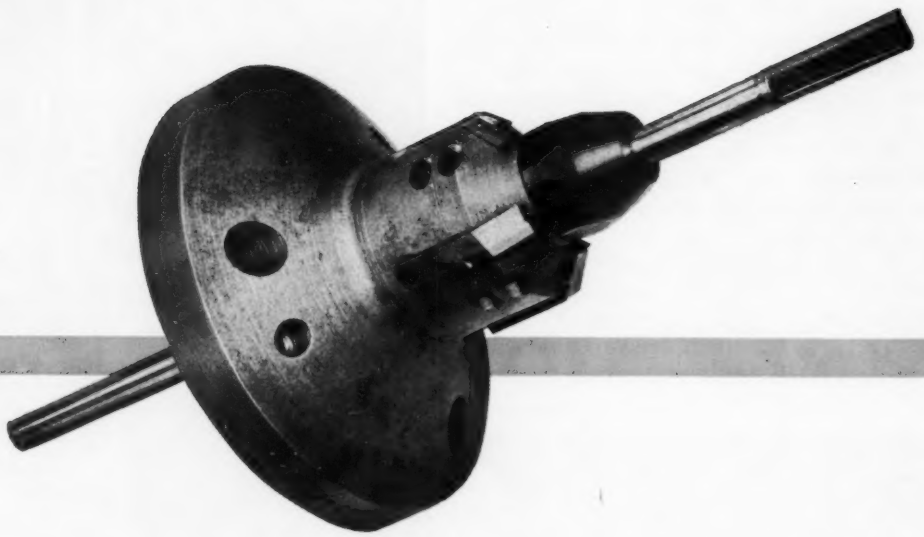


Fig. 9. This coaxial tool plunge-cuts valve seats and gun-bores valve guides in one operation. Boring tool with solid-carbide tip feeds through carbide nose bushing after valve seat has been finished.

above the aluminum heads. A shuttle carries the inserts to the left and positions them beneath individual rams which drive them into the machined recesses in the heads.

The rams function in a three-phase cycle. First, low pressure is applied. If the insert is driven home at this time it indicates that too loose a fit exists between it and the head, leading to rejection. Second, the correct pressure is built up and the insert should seat properly. If it does not, rejection again results because the fit is too tight. Third, high pressure is applied to the ram for ironing, or final setting, of the valve-seat insert.

Valve guides of cast iron are delivered from two Syntron vibratory hoppers atop a separate platform (right, Fig. 7). They are gravity-fed through flexible tubes *B*, Fig. 8, to a shuttle below, and in front of, the casting. The shuttle brings the guides into alignment with the cylinder head, at which point they are engaged by rams and pressed up into the reamed guide holes.

Valve guides and seats are finished in the next section, which is the eleven-station W. F. & John Barnes machine rebuilt and retooled by Lamb. Both cast-iron inserts for any one valve are line-machined in one pass.

One of the tools that do this is illustrated in Fig. 9. Initial contact with the work is made by four carbide-tipped inserts that plunge-cut the valve seat to a 45-degree angle. When the seat has been brought to size, the cutter backs off a few thousandths of an inch and a gun-boring tool feeds out through a carbide nose bushing. This tool, which has a solid-carbide tip, then finish-bores the valve guide. Both tools rotate at the same time: the outer cutter at 600 rpm, and the gun type tool at 3600 rpm.

At another station, special 16-pitch taps are run through all eight valve guides at one time to cut spiral oil-grooves. Before leaving this transfer machine the guide holes are deburred, six intake mounting holes are drilled and tapped, and the cylinder heads are washed with coolant in a six-station barrel fixture.

A final machining operation on a Snyder unit skims 0.020 inch from the joint face (head to block) to assure proper volume of the combustion chambers. An 8-inch diameter cutter having eighteen inserted-carbide teeth is run at 2000 sfpm with a feed rate of 172 ipm. Terminating the automated head line is a second Centri-Spray installation.

DRILL retrofitted for numerical control Actuated by linear hydraulics

ONE OF THE SIMPLEST and most economical tape-controlled machine tools operating on production work at the DeVlieg Machine Co., Royal Oak, Mich., is an American Tool Works radial drilling machine. The retrofit of the radial drill included the addition of a single-axis positioning table on the machine base, heading illustration; an outboard column to lock the radial arm in fixed position; and the numerical control system by Sperry Gyroscope Co. of Canada, Ltd.

The positioning table, as has been mentioned, is single-axis, moving front to back for the Y coordinate. Movement on the X axis is by the spindle head traveling along the fixed radial arm. The casting that fastens the end of the radial arm to the outboard column also supports the linear measuring system that measures and positions the spindle head along the radial arm. A similar measuring system measures and positions the single-axis table. The table and its base were built by DeVlieg.

Measuring from the control systems is achieved through the use of highly accurate linear transducers which provide positioning completely independent of, and unaffected by, conventional machine element traverse mechanisms. The heart of the Sperry positioning control is the measuring element which translates linear or rotary measurements into electrical equivalents that are recognized by the control system. The

Extreme economy in numerically controlled drilling is achieved by a machine tool builder using a novel electronic linear transducer and a pneumatic block tape reader. Preset tooling speeds output

LAURENCE W. COLLINS, Jr., Associate Editor

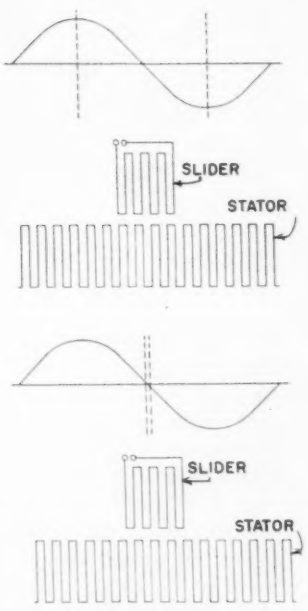
precise linear transducers are electronic scales made of slabs of a glass-mica compound having an expansion coefficient approximating that of steel. The material is extremely tough and durable in industrial use. The slabs are plated (like a printed circuit) with a series of fine, flat, precisely dimensioned metallic coils, each in the shape of an elongated hairpin.

The transducer consists of two major inductance components, a stator and a slider. The stator is built up of sufficient identical slab sections, aligned end to end, to extend the traverse length of the controlled axis to which it is fastened. Each slab section is series-connected to its neighbor, thus forming a long, continuous coil. Because all slab sections are made from the same master and carefully aligned along the side of the fixed element cumulative errors are avoided.

The slider is a single slab section differing only in coil arrangement. It is plated with a series of separate coils, each about 0.025 inch long. The slider is fastened rigidly to the traversing member of the machine. It is placed so as to face the stator with a few thousandths of an inch clearance so that there is no mechanical contact or wear.

Low-frequency, alternating-current excitation of any coil on the slider induces an approximate sinusoidal signal in the stator coil. This signal is at full amplitude when the turns in the energized slider coil are exactly aligned with the stator coil, Fig. 1. But the signal falls off to a null when the two coils are exactly misaligned, Fig. 2. Each coil in the slider is separated from the next one by a given distance, less than 0.001 inch, progressively. Thus, it is obvious that the null points can be shifted electrically in increments of 0.001 inch through the selection of appropriate slide coils.

A simple interpolator circuit further resolves this dimensional value into 0.0001-inch increments. Because each slider coil comprises several contributing turns and the output signal at the stator is the vector sum of all turns, any local dimensional plating errors average out, to all intents and purposes. In practice, a coarse-data element (geared to a small rack mounted parallel to machine traverse motion, Fig. 3) brings the traversing element to about 0.050 inch of com-



Figs. 1 and 2. Operation of the Sperry transducer system is nonmechanical, depending on alignment of the slider and stator output components. At top, signal is at full amplitude because coils align. Bottom shows how a null is achieved through total misalignment.

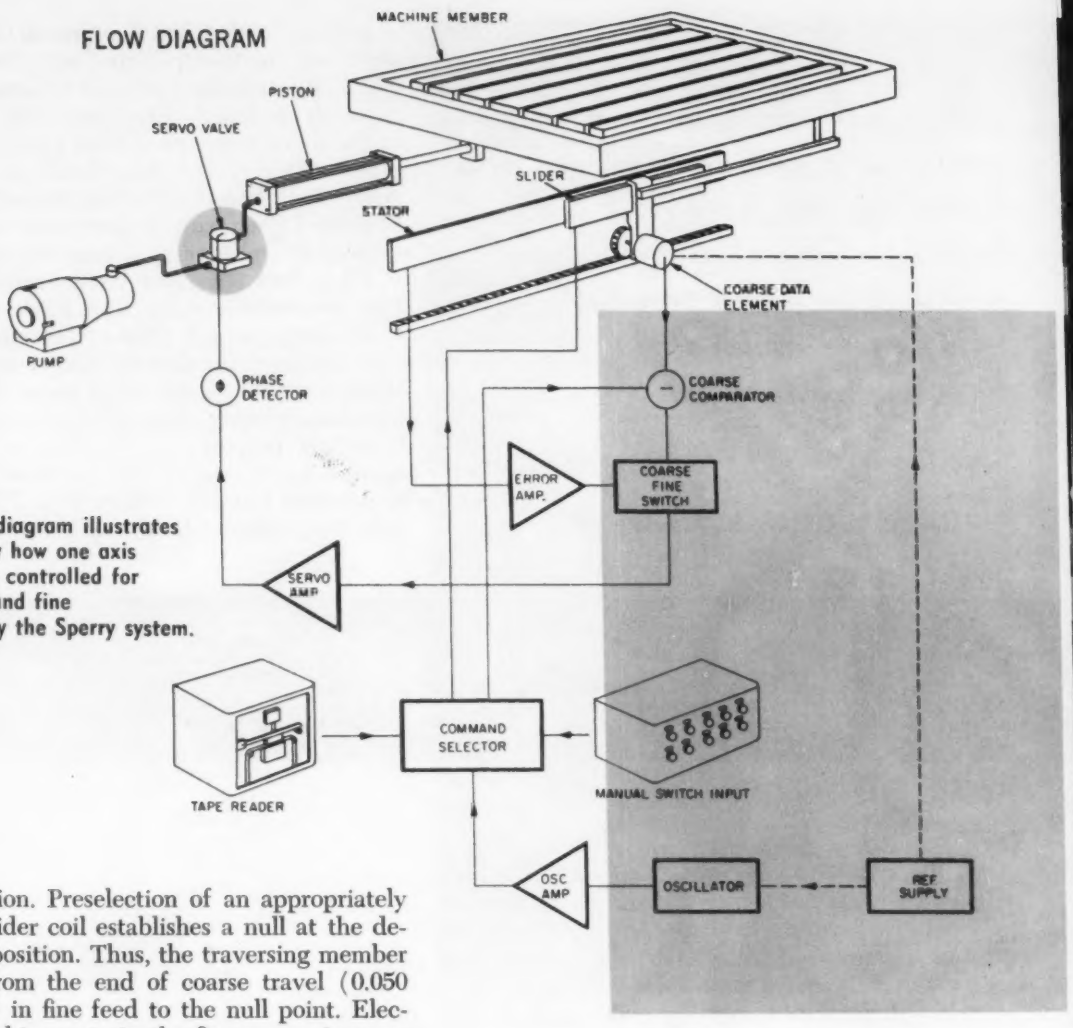


Fig. 3. Flow diagram illustrates schematically how one axis (the table) is controlled for both coarse and fine positioning by the Sperry system.

mand position. Preselection of an appropriately arranged slider coil establishes a null at the desired final position. Thus, the traversing member is driven from the end of coarse travel (0.050 inch away) in fine feed to the null point. Electronic switching cuts in the fine measuring system at the correct stage. An accuracy exceeding plus or minus 0.0005 inch and repeatability of less than plus or minus 0.0001 inch are attained by this arrangement over all conventional traverse distances.

The transducer and coarse-data elements are housed in sealed cases giving excellent protection against chips, dust, dirt, and oil. The linear transducer system measures accurately regardless of the condition or type of traverse mechanism. Consequently it is unaffected by lead-screw windup, backlash, high spots, or dirt. This transducer system thus is ideal for retrofit arrangements using hydraulic piston drives, as in the case of this radial drill at DeVlieg, because there is no necessity for linear or rotary conversion. The digital coil-selection techniques employed in the fine-measuring phase obviate critically balanced and calibrated analog circuitry. Positioning is positive without hunting or drift problems. Economical and conventional analog circuitry is used in the noncritical coarse-measuring phase of the systems.

Data input to the machine is in the form of standard 1-inch paper tape, programmed in standard IBM binary-coded decimal language. The Sperry of Canada tape reader differs from most other data-reduction systems. In the usual system each line of punched holes in a command block is read from the tape one line at a time into a shift register or memory system for storage. After the tape program block has been completely read, the block is released in full to the control system. The Sperry system instantaneously reads a whole twenty-line block at once and retains the data in the reader during the machining cycle. Advantages of this kind of reader are two: (1) A reading speed of ten blocks per second can be achieved, and (2) the need for a shift register or other memory unit is eliminated.

The reader works pneumatically, roughly analogous to an old-fashioned player piano in that

the tape covers a grouping of holes in a plate. A tube runs from each hole to a small air diaphragm. The system is filled with air under light pressure. When a hole in the tape releases air at one of the reader holes, the corresponding diaphragm collapses and trips a precision electrical switch, thus setting up commands in the control system. The tape advance is by the type of Geneva movement used in movie cameras. The entire cabinet for the reader is gasketed so that it is slightly pressurized against the entrance of foreign matter. Another advantage of the air-operated tape reader is that it has no mechanical fingers or electrical brushes to wear or otherwise cause faulty commands.

A feature that speeds and simplifies the power drive of the system is a rotary electrohydraulic servo valve specifically adapted for use with hydraulic cylinders such as that used on the radial drilling machine. The design of this valve originated in the contention that a hydraulic cylinder is desirable for moving large masses at exceptionally high speeds in order to overcome many starting and running friction problems inherent in large machine tools. In the past, however, it has always been difficult to control the cylinder. The new electrohydraulic servo valve overcomes this machine tool cylinder problem. It has a high immunity to dirt and requires no destructive dither impulse for smooth and instantaneous operation. Used with hydraulic pistons, the valve gives a fast, accurate drive without the use of ball screws, roller ways, or other technical gymnastics to overcome friction and inertia. How the experimental valve operates is shown schematically by the two contrasting positions in Fig. 4. It consists of a spindle that rides on bearings in a bored housing with portings arranged sym-

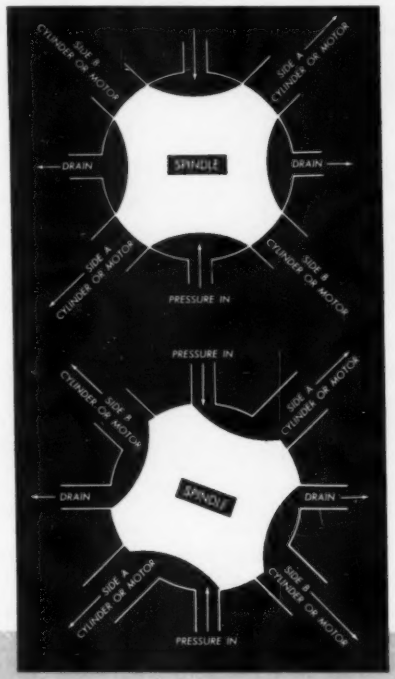


Fig. 4. (Right) Schematic diagram illustrates operating principle of a special electrohydraulic servo valve used on the retrofitted radial drill. It is not commercially available.

Fig. 5. (Below) Motor mounting plate for a DeVlieg machine tool is drilled by tape control according to dimensions from this special drawing, which has a check point at the lower left.

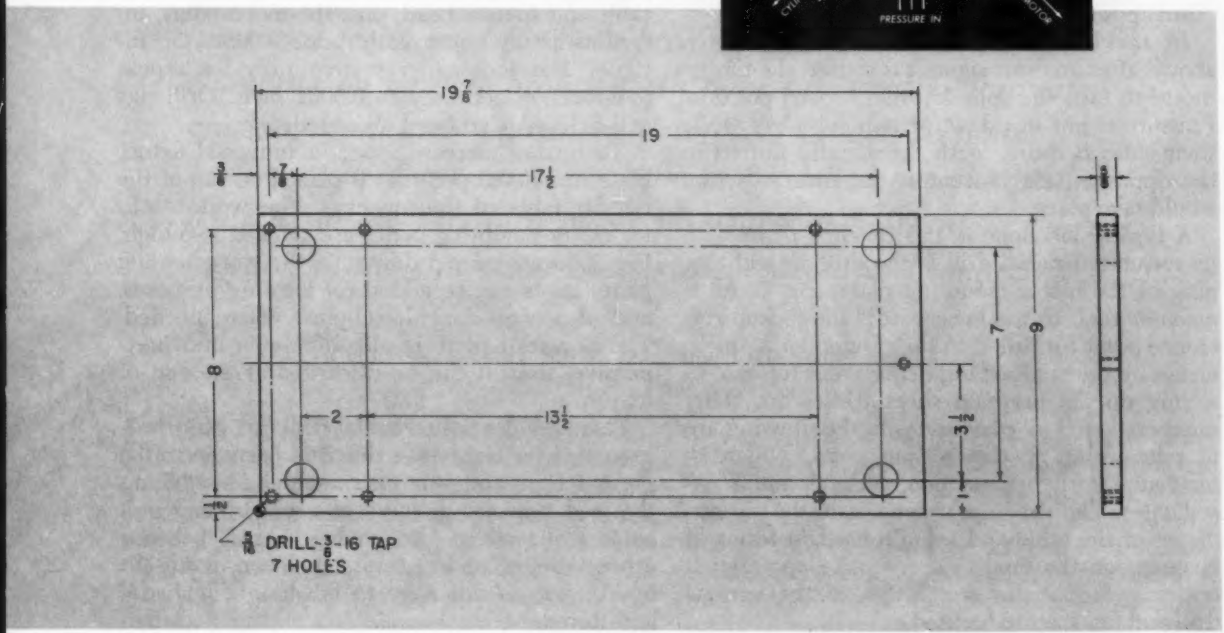


Fig. 6. (Below) Fast tool changes and precise dimensional repeatability result from adaptation of DeVlieg's Flash-Change tool-holders to the drill spindle.

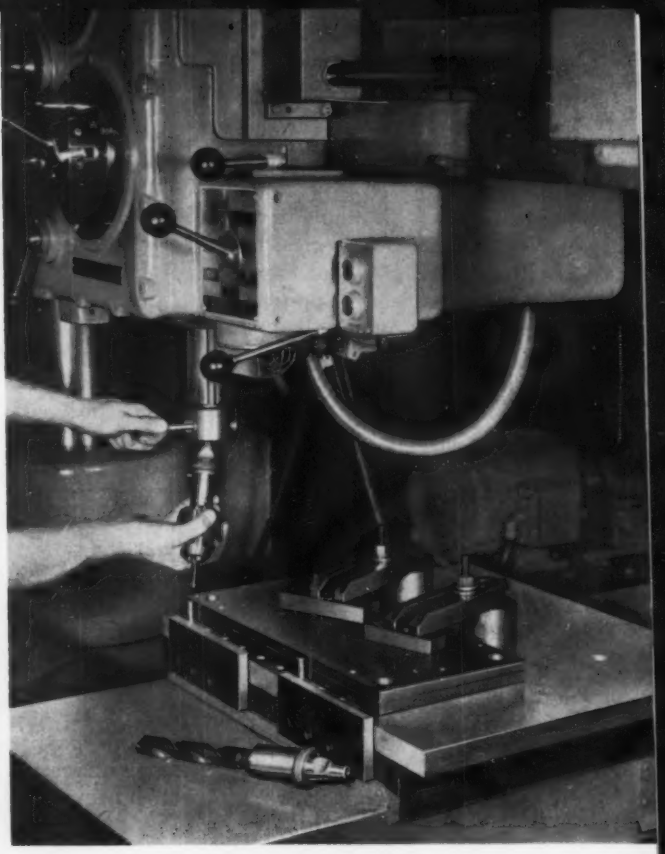
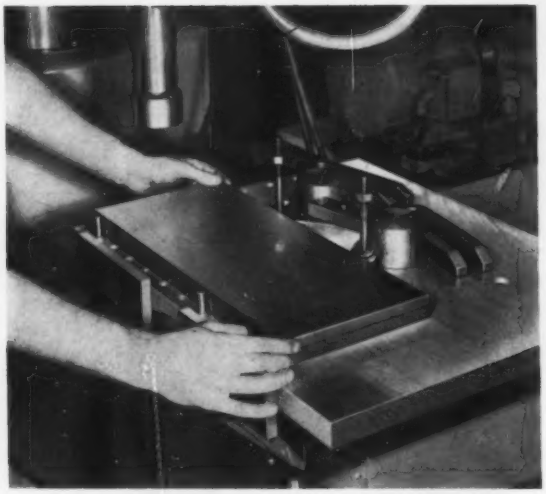


Fig. 7. (Right) Stacked two-high for drilling and tapping, motor mounting plates are located from dowels in this universal fixture for drilling.



metrically. A torque motor, coupled directly to the shaft, rotates the spindle on its axis in accordance with error signals received from the phase detector. In the setting at the top, the valve is in "shut" position and the drain ports are closed.

In the lower diagram, Fig. 4, the valve is shown after an error signal has caused the torque motor to turn the spindle to an "open" position. Pressure is put in side *A* of two cylinders while their sides *B* drain. With the spindle shifted to the opposite side of center, the reverse action would take place.

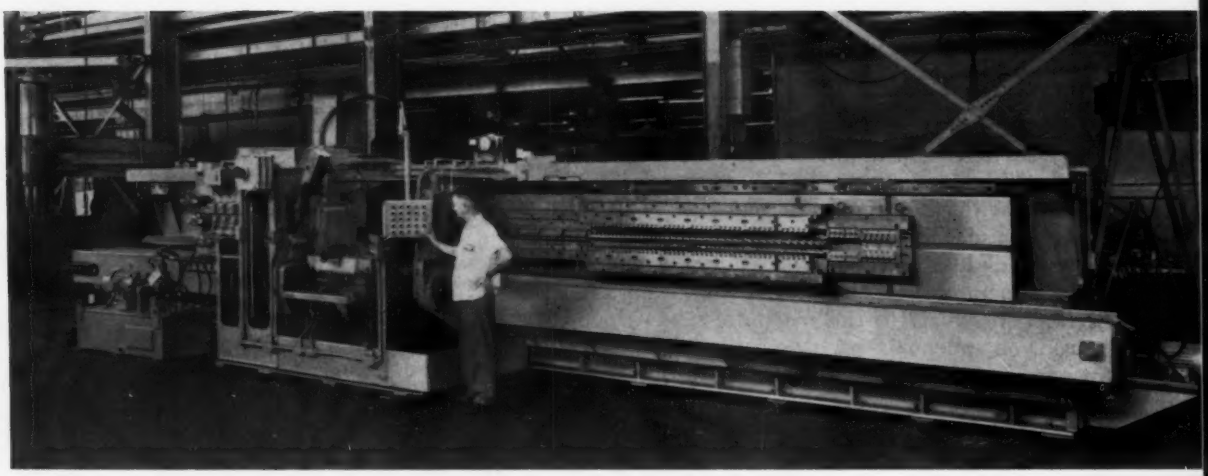
A typical job done in the DeVlieg plant with its retrofitted radial drill is the drilling and tapping of the motor mounting plate, Fig. 5, for a machine tool. In the lower left is the pickup reference point furnished to the programming technician by the engineering department for ease in setting up the program sheet. Holes are code-numbered, and all dimensions in the drawing are in relationship to this pickup point, which is, incidentally, the intersection of the X and Y coordinates. The program sheet charts the various moves of the table and spindle head in terms of channels on the tape in a complete operational outline which includes a listing of the various drill and tap sizes to be used.

In conventional drilling operations with drill jigs, floating tool-holders are used. Thus, the center-to-center accuracy of the holes drilled depends upon the accuracy of the drill bushings and their positioning in the drill plate of the jig. DeVlieg adapted the spindle of the radial drill for use with its own Flash-Change tool-holders, Fig. 6. The tape-controlled positioning of the table and spindle head, plus the tool-holders, increases productivity and reduces operator fatigue. The tool-holder system provides repeat tool-location accuracy to 0.0001 inch. Drill jigs and fixtures have been obsoleted.

To further increase speed, a universal fixture plate was developed that is placed on top of the regular table of the machine. The work-blanks for motor mounting plates are stacked two-high, Fig. 7, locating from dowels in the work-holding plate. Pilots can be added for locating purposes, and also occasional dowel-pins, where needed. The universal plate is soft aluminum and inexpensive; thus, it can be discarded at the end of its run.

This tape-controlled radial drill has been programmed for eighty-five different parts up to the present time and was instrumental in reducing the lead time for delivery of new DeVlieg machine tool models. Also, savings accrue because expensive jigs and fixtures, time-consuming to build, now do not have to be designed, made, and stored.

broaching with cemented carbides



The application of cemented carbides to broaching has been facilitated by the development of high-speed machines. Improved techniques for both brazing and clamping on carbide broach teeth have practically eliminated cracking. Similarly, advanced designs of broach sections have increased the number of pieces broached per sharpening. This is an abstract of a paper presented at a recent meeting of the American Society of Mechanical Engineers

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PRIOR TO ABOUT 1952, broaching was limited to the use of high-speed-steel broaches, primarily because there were no machines available having adequate speed to avoid the formation of a built-up edge on the cutting teeth. At that time the broaching machines being made usually had a maximum speed of around 65 sfpm. Since virtually all metals and alloys have a critical cutting speed below which a built-up edge forms, the logical place to start development work was naturally at the machine tool. Adequate power, rigidity, fast acceleration and deceleration, and smooth travel of the slide, as well as automatic cycling were required features. Furthermore, it was desirable to provide for rapid chip disposal, sufficient coolant where required, multiple auto-

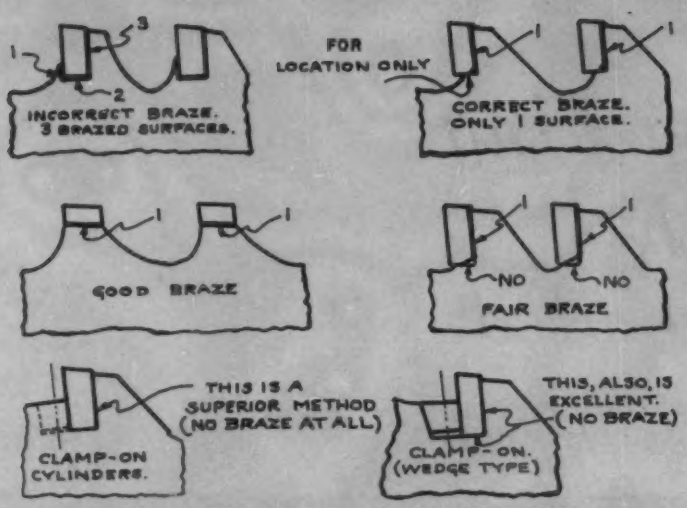


Fig. 1. Comparisons and examples of various methods of brazing and clamping cemented-carbide teeth to broach bodies.

matic fixtures for fast loading and unloading, and easily serviced and adjusted broach sections of simple design.

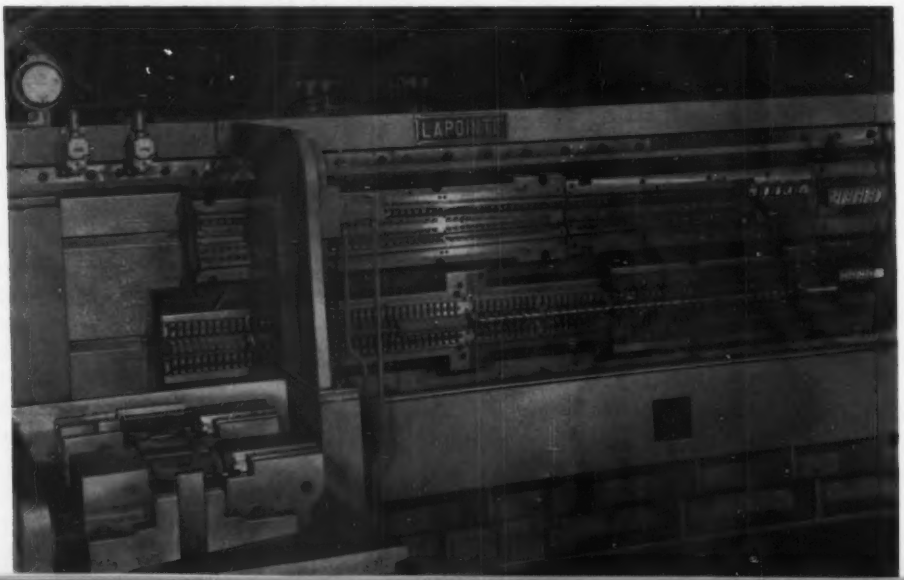
Thus, with this concept of the problem, a broaching machine of the horizontal type was designed and built. The drive was electric, of the motor-generator type, and was applied through herringbone gears to the machine slide, which moved on phenolic pads to reduce friction. Speeds ranged from about 15 to over 400 sfpm, and the over-all length of this first machine was approximately 50 feet.

All controls were automatic. Acceleration and deceleration were accomplished within about 4 to 5 feet of the beginning and end of the required stroke. In addition, a refrigeration unit was incorporated to maintain the coolant at a fairly low temperature (around 40 degrees F.), and an appropriate filter was installed for cleanliness. An air blast was provided to scavenge chips from around cutter teeth, particularly if the broach was operated without coolant. Such equipment—exemplified by the single-ram, horizontal, electric-drive broaching machine seen in the heading illustration—proved to meet every requirement for fast, precision broaching with cemented carbides.

Broach Design

The early applications of cemented carbide were mainly on lathe tools of the brazed-on variety. During World War II, clamp-on types were developed and a considerable increase in tool life was noted—especially when double negative rakes were employed in turning parts such as shells. From this experience, these same ideas were applied to broaches with marked success.

Fig. 2. The slide of this single-ram, high-speed, electric-drive type machine is shown arranged with two broaching setups, one above the other.



Brazed-on designs, when properly executed, have proved entirely satisfactory, particularly with smaller carbide blanks. Induction brazing has been notably successful. On the other hand, where carbide blanks were relatively large (on the order of 1/4 by 1 by 9 inches), brazing required special handling to avoid cracking the carbide. Although large pieces of cemented carbide are regularly secured to steel broach bodies by brazing, the better and safer method is to clamp on the blanks, using wedges for holding purposes, Fig. 1. It is most important, however, to remove all burrs.

In many cases, small carbide blanks (5/16 by 5/16 by 2 1/4 inches) brazed on small steel shanks have not only performed well but, in addition, their use has lowered costs of tooling. One such application is a bearing-cap casting for the main bearings of automobiles. The small shanks are mounted in suitable holes located helically along the length of the broach body, with end-screw adjustments being provided for setting the heights of the cutters. This arrangement allows broken or worn tools to be readily replaced. In the section following these radial roughing "nibblers," solid round sizing rings finish-broach the final half-circle cross section to provide accurate dimensional control and a smooth surface.

This same technique can be applied equally well to flat surfaces such as cylinder heads. The original casting is brought nearly to size by rough nibbling (using stagggered small tool inserts) and is finished by long, solid carbide blanks of the clamp-on type in the following broach section.

Broach Shapes

Since work-pieces can and do vary greatly in geometry and dimension, broaches rarely have a so-called standard shape. They are custom-designed to generate work-piece configurations. The size and type of broaching machine available for the work must also be taken into consideration. Generally, the machine, fixtures, and tooling are designed as a "package" to meet the requirements for mass-producing a specific part. Exceptions to this, however, are not infrequent. In Fig. 2, a Lapointe high-speed broaching machine is shown set up for performing two operations on a single slide.

Carbide broaches vary in shape from circular, for sizing round holes, to those that produce combinations of curved, angular, and flat surfaces. Examples of broached work-pieces include jet-engine components and many automotive parts, Figs. 3 and 5. In Fig. 3 cylinder heads are shown being broached on a Cincinnati machine at the Lima, Ohio, engine plant of the Ford Motor Co. The operations performed in this instance are: rough and finish broaching of top, intake, and

Fig. 3. Here, an engine cylinder head is broached as the initial operation on a long machining line featuring extensive use of automated equipment.

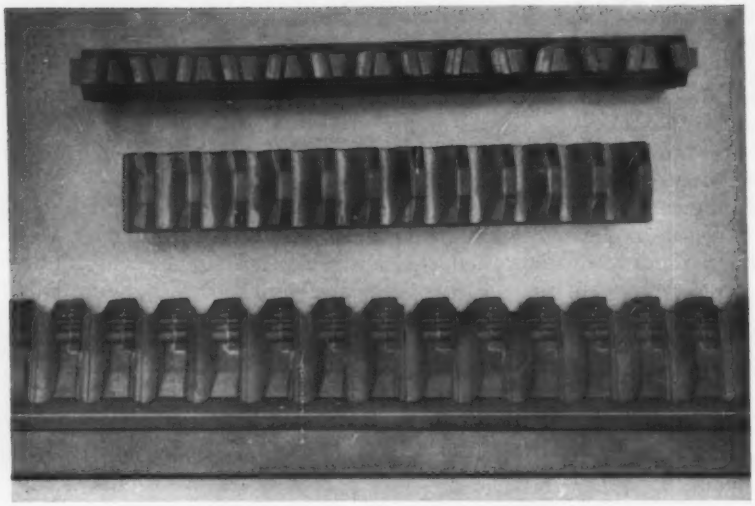


Fig. 4. A few typical carbide broaches. Machine, fixture, and tooling are often designed as a package for a specific part.

Fig. 5. (Below) Chrysler front-wheel brake cylinder broached on a continuous type machine.

exhaust manifold faces; and rough and semifinish broaching of the block joint face. Stock removal is 3/16 inch on each surface, and the production at 80 per cent efficiency is 133 pieces per hour.

Gun barrels are rifled and pistol barrels are burnished by carbide broaches. Impeller wheels, gear splines and teeth, Stellite liners, and babbitt bearings are other typical broaching applications.

Ordinarily, neutral or positive back rakes (up to 5 degrees positive) are used for relatively soft materials. However, negative back rakes (up to 5 degrees minus) serve well in roughing operations on irregular castings or castings with imbedded foundry sand. There is less breakage and longer tool life in the latter instance. The broach body, in many cases, incorporates the desired rake angles to eliminate grinding them on an otherwise conventional tool insert. This makes the initial cost of the broach greater, but the saving obtained through elimination of excessive grinding of inserts is profitable in the long run.

Of great importance is the provision of adequate supporting steel to back up the carbide blank in the direction of tool travel. At least three times the blank thickness should be available as support. Bear in mind that stiffness increases as the square of the thickness of the backing steel, but increases only directly as the width parallel to the cutting edge. Also, the overhang of carbide tools should not exceed the dimension of the supporting steel in the direction of tool application. Typical carbide broaches are seen in Figs. 4 and 6.

The choice of steel for brazed-on carbide tools is somewhat critical and deserves special comment. Generally, on small tools, a braze material such as Handy & Harmon Easyflo No. 3, used with Black Flux made by the American Platinum Works, is satisfactory. The greatest strength (130,000 psi) is obtained when the braze thickness is about 0.0015 to 0.0025 inch, but this strength sharply decreases as the braze thickness increases. Sometimes braze shims of the so-called sandwich type are used for larger carbide blanks. In either event, the braze material has a definite range of melting (1195 to 1270 degrees F. in the case of Easyflo No. 3).

Different percentages of carbon in the plain carbon steel such as SAE 1020, 1045, and 1095 definitely affect the heating and cooling curves, if heated above the transformation point. It is thus possible to have a case where the braze alloy is shrinking while the steel broach body is expanding. Cracking necessarily follows. The ratio of the coefficient of expansion of steel to that of cemented carbide is about 2 or 3 to 1. This, per se, is quite drastic, and improper steel selection only adds to an already troublesome situation. Hardened high-speed steel has been used for carbide broach bodies in cases where thin, delicate sections were required.

In designing broaches, it must be remembered that cemented carbides are harder than, but not as tough as, high-speed steel. Therefore, consideration must be given to the protection of carbides from abuses arising from impact and overhang. Clearance angles, as well as planned load

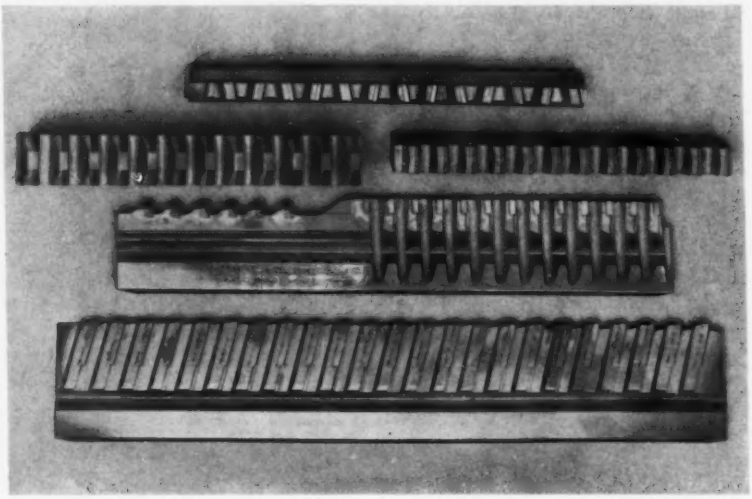


Fig. 6. Some additional examples of carbide broaches showing a wide variety of tooling possible.

per tooth, are generally the same for either tool material.

Design details of broaches having brazed-on blanks are important. For example, the milled notch in the steel body should be designed to virtually prevent braze material from being applied to more than one face of the blank. The stress (pull) exerted between the blank and body should be only in the direction of the stroke. Stresses occur at right angles when braze is applied to both the rear face and the bottom of the blank, Fig. 1. In short, the less preload given a blank, the better.

Great economy may be effected through the intelligent planning of the shapes of carbide purchased in the rough. Sections of the broach can be designed in such a manner that a very minimum of grinding will be required. Futhermore, most carbide manufacturers can and will hold tolerances on the rough blanks to plus or minus 0.004 inch in all directions. A "green," or presintered, blank is about as soft as black chalk and can be drilled or ground as easily. This suggests that if 1 1/2 to 3 degrees of back relief or clearance is ultimately required, a blank with an 8-degree clearance angle should be purchased. Only the grinding of a "land" about 1/32 inch wide is then necessary, Fig. 7.

Seldom does the front face of the blank have to be ground. But if such grinding is required, the whole blank should be tilted forward 5 degrees in the rough-braze position and then, as in the case of the clearance angle, only a slight land need be provided.

For some broach applications, as many as 1400 or 1500 individual carbide teeth are employed. Considering that each tooth is preferably diamond-ground and that grinding hard carbides with diamond wheels is costly, the less grinding per tooth, the better. Great reductions in the original cost of broach sections, as well as in the cost of resharpening, are thus made when care in design is exercised. Another cost-reducing technique is to "pretin" the face of each blank before it is applied to the steel body. This guarantees a virtually perfect braze and eliminates guesswork regarding the coating of the blank surface with the braze material. A further check may be made by striking each tooth with a nylon mallet of appropriate size. Visual inspection of the braze can be deceptive.

Grinding is equally important. The preferred method is to use a 100-grit, phenolic-bond diamond wheel for roughing, and a 220 or finer grit for finishing. Silicon carbide is sometimes used, but for broaches it is not very satisfactory except for "hogging off" superfluous stock. Recalling the fact that broach teeth vary in size, one from another, by ten-thousandths of an inch and that no two teeth are alike, it is apparent that grinding techniques must be the ultimate for quality.

A surface roughness as low as 1 1/2 microinches can be attained. The ratios of cutting speeds for carbide broaches to those for high-speed-steel broaches usually range from 2 to 1 upward. Carbide tool life runs from five to thirty or more times that of high-speed steel. There are from four to twenty regrinds obtainable on a carbide broach, depending upon the application. This is several times more than that for a high-speed-steel broach on the same operation.

Selecting Cemented-Carbide Grades

The better acquainted one is with the chemical and metallurgical aspects of cemented carbide, the better able he is to select the proper grade. For example, several different kinds of carbide

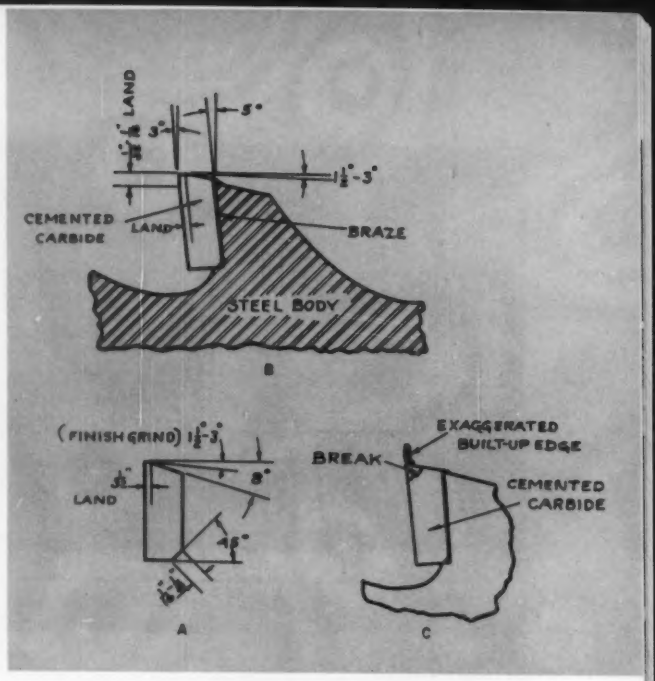


Fig. 7. After rough blank (A) with 8-degree clearance is brazed to body (B), a small land is finish-ground to the required 1 1/2- to 3-degree clearance angle. Tooth with built-up edge (C) generally breaks as shown.

are used in industry: tungsten carbide, tantalum carbide, titanium carbide, columbium carbide, and tungsten-titanium carbide. These are customarily cemented together with metallic cobalt. Other binders are nickel and platinum. Even iron can be used if desired.

Usually strengths are governed by the percentage of cobalt binder used, although there are other factors, such as grain size and sintering control. The object of the binder is to provide strength (via metallurgical "wetting" of the carbide) and high red hardness. Roughly, a rule of thumb is that the more binder, the tougher; and the less binder, the more brittle. Also, the more binder, the less wear life; the less binder, the greater resistance to wear. These, of course, are but broad generalities.

Carbides other than tungsten are usually employed for resistance to crater, which is evidenced by the pocket that wears on the top of a lathe tool. Tungsten carbide is generally used for abrasion resistance, an altogether different manifestation.

Since broaching is most often carried out with tooth depths as small as 0.0001 up to 0.017 inch, there is little opportunity for crater to manifest on the front face of the tooth. Under such conditions, the problem is almost entirely that of abrasion. Hence, grades containing tungsten carbide (or tungsten carbide with small amounts of any of the other carbides named) plus cobalt binder in amounts from about 3 per cent (for finishing teeth) to 8 per cent (for roughing teeth) are generally selected. Broaching uranium 238 is best done with a tungsten-carbide, tantalum-carbide (plus cobalt binder) grade to offset the tendency of this metal to weld to the cutting edges.

The Built-Up Edge Problem

Normally, build-up does not occur or seldom causes any trouble when cast iron is broached because the chips are of a crumbly type. There are other cases, however, where build-up does form, and with disastrous results.

The built-up edge (Fig. 7) on a cutting tool can be and often is as much as 200 to 300 per cent harder than the material from which it was formed. Where build-up occurs the engineer is faced with this problem: the carbide cutting edge has had another material welded to it. This is destructive because the build-up tends to break off and carry with it a portion of the original carbide cutting edge. Dull or broken tools and torn and ragged finishes, with drastically reduced tool life, are the result. Although occasionally no solution seems possible, there are several methods which may alleviate this condition:

1. Use of very cold coolant;
2. Use of mineral oil containing molybdenum disulphide;
3. Trial of different coolants;
4. Refrigeration of the work-piece to low temperatures;
5. Experimentation with carbides having a platinum binder (such grades now exist), if the cost is justifiable;
6. Change of the cutting angles from positive, through neutral, to negative rakes;
7. Variations in cutting speeds;
8. Small variations in tooth load.

Sometimes the slightest change by any of these methods will stop formation of a built-up edge.

One successful blank design used by the author was that of solid-carbide cylinders set at double negative angles. Each was attached to the steel broach body with countersunk head screws through a hole in the cylinder centered on the lengthwise axis. Both circular faces are usable and indexible to as much as six settings around each face. Thus, twelve settings are available per grind. When fifteen regrinds are possible, 180 sharp edges can be obtained from the blank. This double negative rougher design eliminated built-up edge.

Cutting Speeds

One method of determining the cutting speed for a carbide broach is to select from the handbooks the normal machining speeds for high-

speed-steel lathe tools, and double this value. Then, observe whether or not a built-up edge is formed. If it does not form, the speed is safe. If one does form, remove it with an aluminum-oxide hone and increase the cutting speed until the built-up edge fails to occur.

Another factor that affects the selection of broaching speed is the fragility of the work-piece and/or the fixture. Usually, good design eliminates these conditions.

The maximum operating speed of high-speed-steel broaches is about 65 sfpm on practically all applications. Broaching with carbides has been done as fast as 300 sfpm and higher. The chip load per tooth for high-speed steel ranges from 0.0001 inch (burnishing) to 0.017 inch; carbide, as previously mentioned, will operate under the same loads per tooth.

Present Carbide-Broach Limitations

There are limits to the use of carbides for long broaches of very small diameter that require high tensile strength.

Pieces of carbide are generally limited to sizes not much greater than 3/8 by 1 by 9 1/2 inches or rings not much larger than 9 inches in outside diameter. They could be made larger if there were a demand.

In some cases the speeds available in the machine are slow, preventing the use of carbides. The harder the material, however, the slower the cutting speed tolerable.

Applications with limited production and/or operations too large in size prohibit the use of cemented carbide, from an economic angle.

Isolated cases requiring excessive tooth loads may also prevent the use of carbides.

Excessive chatter or vibration within the machine, work-piece, or broach (in no case to be tolerated) are further limiting conditions. Usually, however, they can be corrected.

Tool Materials

To be of any value, a tool material must have cutting edges that resist heat, have high hardness at the tool-chip interface, have adequate strength, have suitable wear resistance, and be sold at a price justifying its use. Demands are for higher production rates with greater wear life between sharpenings, and at substantially lower cost per piece. The limits for each tool material can be directly connected with its inherent ability to retain hardness and strength at ever-increasing tool-chip interface temperatures. Some of these limits, in terms of degrees F., and the associated hardness, in Rockwell A, are as follows:

At 700 degrees F., high-carbon tool steel is 65 Rockwell A

At 1300 degrees F., high-speed steel is 65 Rockwell A

At 1500 degrees F., cemented carbide is 80 Rockwell A (approximately).

Expressed in another manner, the first two cutter materials will soften at temperatures in excess of those indicated and become worthless. Carbide can operate at a considerably higher temperature and remain hard; ceramics go far beyond carbide in this respect.

During the past ten or more years, numerous investigators have delved deeply into the subject of tool thermodynamics, both by a thermocouple analysis and a mathematical approach. With close approximation, they have shown that tool cutting-edge temperatures can and do run high—1800 degrees F. and higher. From this alone, it is readily observed that the higher cutting speeds require cemented carbides to withstand the resultant cutting temperatures. Even better materials are needed because carbide, too, has its thermal and strength limitations. Because of its upper thermal limitations, and physical strengths, engineers have long searched for replacement tool materials. Currently the direction of this research is toward cermets, ceramics, and borides.

Coolants and tool geometry alleviate high tool-chip interface temperatures to a certain degree. They aid in maintaining lower temperatures, but likewise have their limitations; hence the need for research in ultra-high-temperature tool materials. The jet-engine and atomic-energy programs have intensified this activity. Most coolants react chemically with the tool and/or work-piece materials, producing a sulfide or chloride coating of low shear strength which usually serves as an "antiweld" plating. As an offsetting condition, chemical reactions require time, and time is lacking at cutting speeds above 50 sfpm. In other words, at the operating condition where coolant is most urgently needed (at high speeds and high temperatures) it proves of little value chemically or in removing heat by conduction.

Tool geometry changes (such as to keener cutting "wedges") are also limited, as they are governed by the relative tool strengths. Here, again, greater strengths are needed at high tool loads. Thus, the tool materials in use are becoming harder and harder, with greater heat resistance to softening (an advantage), while the physical strengths are dropping instead of improving. Therefore, the harder the tool material, the more refined become the tooling techniques required. This dictates the trend to clamp-on holding, and double negative rake angles.

Forming stainless steel percolators at 4000 a day

Body of these electric coffee brewers is drawn in four stages with bright annealing between. Hydroforming is used for the first two steps

QUANTITY MANUFACTURE of the modern automatic electric coffee percolator may seem, to the uninitiated, to involve relatively few problems. Those directly involved, however, are well aware that such production is not achieved without difficulty. This has been demonstrated fully in the recent experience of Landers, Frary & Clark. One of its plants in New Britain, Conn., has been, and continues to be, the world's largest producer of this type of appliance, hence its management knows well what is involved in holding this position.

Assembly and finishing lines are geared to turn out, test, pack, and ship about 4000 percolators

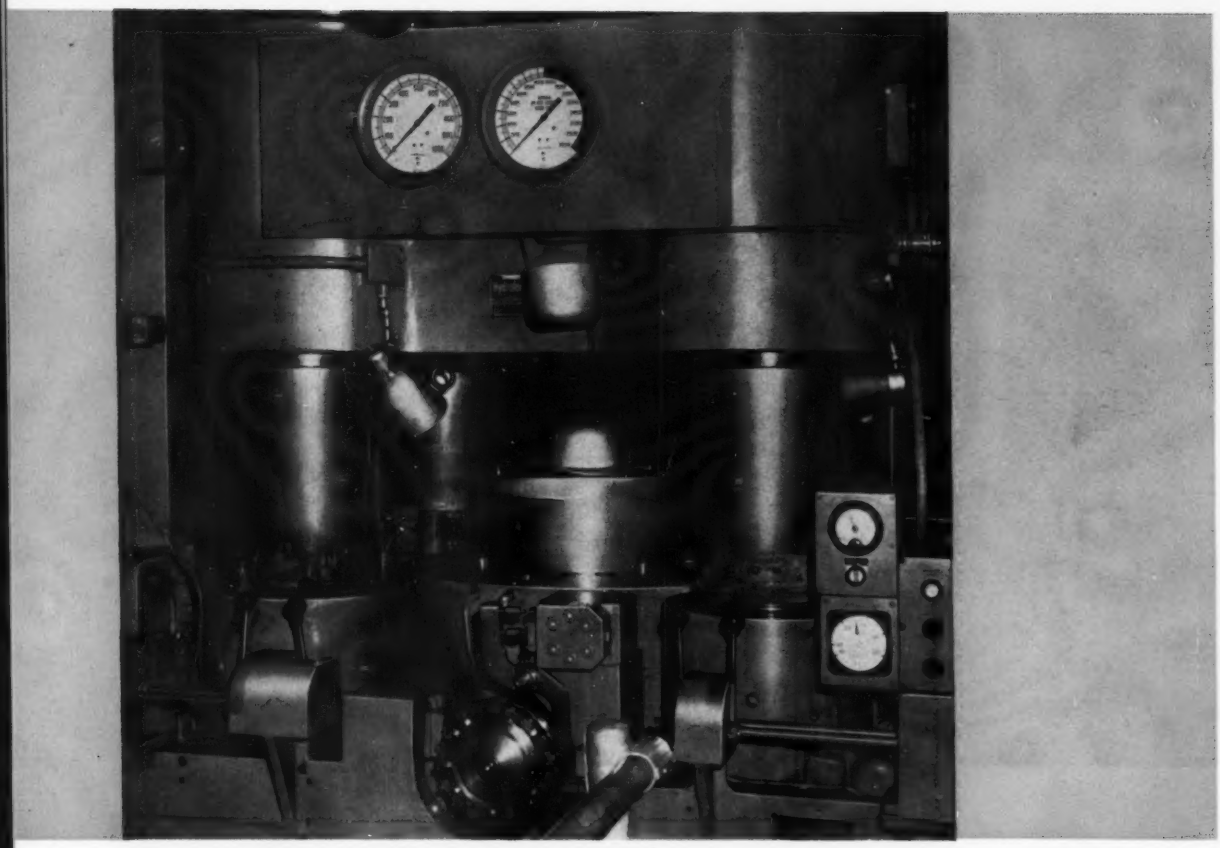


Fig. 1. (Left) Percolator body as it appears after successive press operations. It starts out as a circular blank of Type 302 stainless steel.

Fig. 2. (Above) Work-piece is seen after first Hydroform operation. The cup-shaped part is 4 1/2 inches deep with an inside diameter of 5 3/4 inches

a day. This output can be stepped up considerably because of expanded facilities that make it possible to produce a new stainless-steel Coffeematic in addition to several models using primarily copper bodies and covers. These lines can be operated either separately or simultaneously, but as the new stainless model does not require an applied finish, most of the plating equipment is not needed on the newer line.

Besides making and marketing its own Universal line of Coffeematics, the plant produces considerable quantities of nearly identical electric percolators for other companies, among which are large mail-order firms. Other trade names are applied to these as specified by the customer. With this exceptionally large total volume it is possible, if not essential, to attain a high degree of economy as well as to maintain dependable quality.

To meet insistent demand for stainless electric percolators, considerable new equipment had to be added: first, because new styling required stampings of different shapes; second, because stainless steel is more difficult to draw and shape than is copper. Major problems arose in producing the percolator body. Although designed to simplify forming (as well as to afford a new and pleasing shape), the total draw is 9 1/2 inches deep and only 4 5/8 inches in diameter near the bottom. Flaring and beading are required at the top. Fig. 1 shows the body as it appears after successive press operations.

Four major dies are used for drawing the body, and annealing is done after operations in each of

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Fig. 3. Bright-annealed stainless-steel cups, some of which are for electric percolator bodies, leave cooling chamber of the furnace on a continuously moving wire-mesh belt.

the first three dies. Also, some local annealing is required for beading. This is necessary because the AISI Type 302 stainless steel being used is not easy to draw and work-hardens during each press operation.

Production of the stainless percolator body starts with semiautomatic spray lubrication of the 15 7/8-inch diameter, 0.025-inch thick blank on a motor-driven turntable. Castor oil is used only on the top face, which is the one that contacts the rubber cup in the press. After the operator places the blank on the turntable he presses a button which activates the table and starts the spray gun. Both stop automatically after a set time that is sufficient to permit application of a thin film of lubricant.

With the sprayed blank lying on the bottom die in a Cincinnati Hydroform press, the machine is started and runs through its cycle automatically. In this cycle the punch moves up from its low position and presses the blank against a rubber cup flange. Then, hydraulic pressure of 2000 psi is applied to the outside of the cup, pressing the center portion of the blank around the punch as it moves upward. When the punch stroke is completed, a presure of 9000 psi is applied for a set time. This completes the initial draw, Fig. 2, yielding a wide-flanged cup that is 4 1/2 inches deep and has an inside diameter of 5 3/4 inches. About ninety pieces an hour are produced on one press.

Little or no thinning of the metal occurs in this first draw. Often, however, the flange does not remain flat. In such cases it is struck in a separate flattening die after the piece passes through an alkaline spray and undergoes bright annealing. This same washing is also done before each of the two subsequent annealing operations.

Annealing is done in the continuous type Sargeant & Wilbur furnace, Fig. 3, which is provided with an atmosphere of dissociated ammonia. The parts, loaded onto a wire-mesh belt conveyor by hand, pass through a curtain of burning gas (to exclude air) on their way to the heating zone. A temperature of 1950 degrees F. is reached before they enter the cooling zone, where it is reduced to about 200 degrees F. Belt speed is set to carry the parts through a complete furnace cycle in twenty-five minutes. Use of the ammonia atmosphere keeps the parts bright and free of scale.

Following this first anneal the parts go to a press that flattens the flange (if necessary) and then, after relubrication, are returned to the Hydroform press where the second draw is made, Fig. 4. This draw yields cups 7 1/2 inches

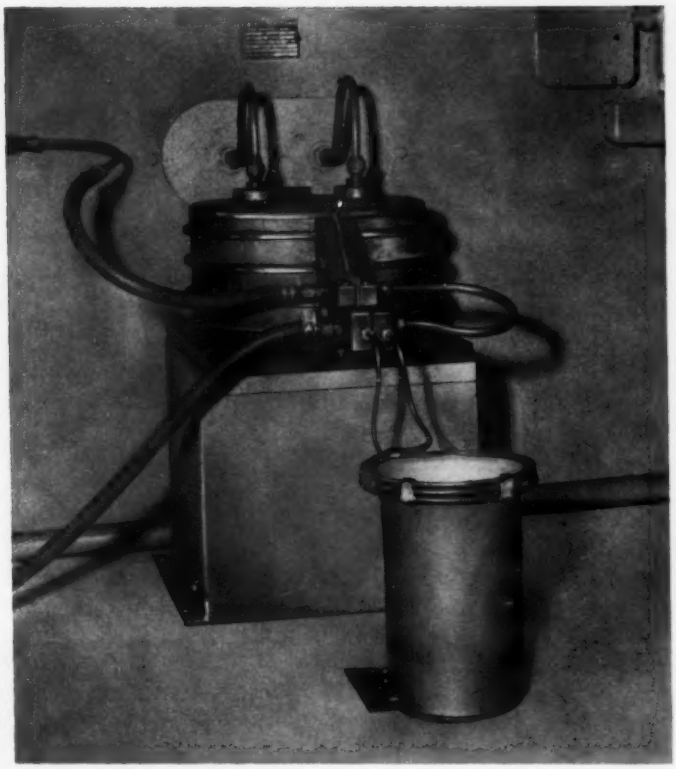
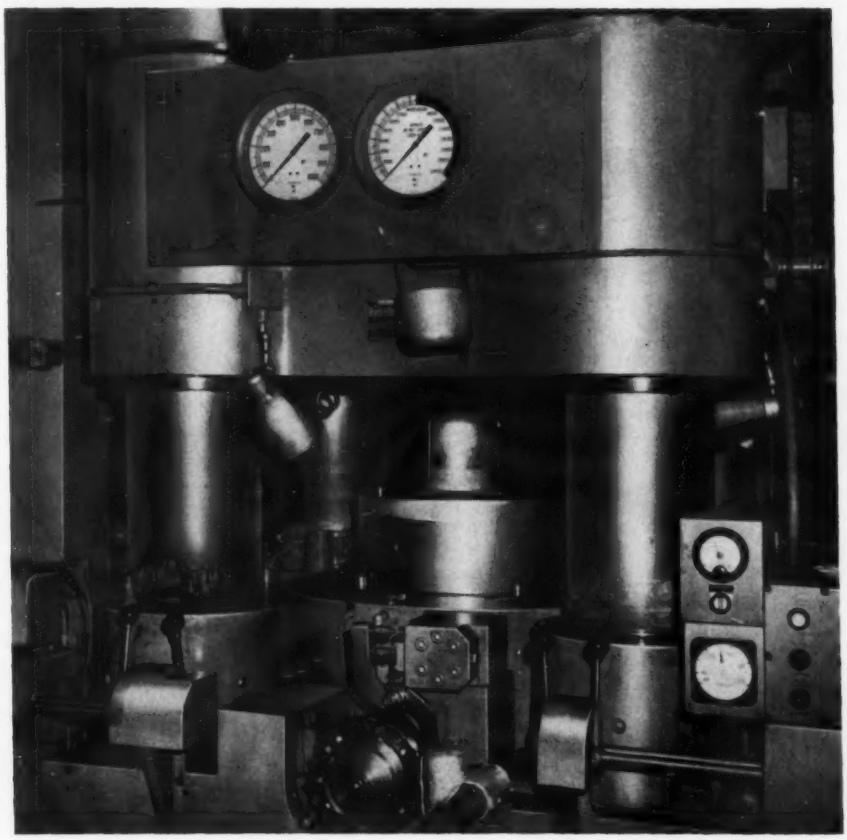


Fig. 4. (Below) Cup for percolator body shown immediately after second Hydroform step. The narrow remaining flange is later trimmed off in a lathe operation.

Fig. 5. (Right) Two induction-annealing operations, using the setup shown here, are needed to facilitate two-stage spinning of the bead at the top of the percolator body.



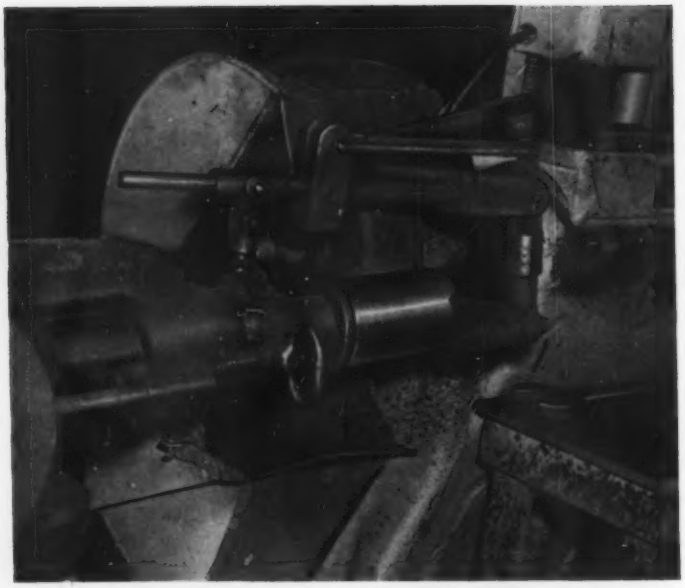


Fig. 6. First of two polishing operations on the exterior surface of the body, using a rag wheel with 280-grit emery and grease.

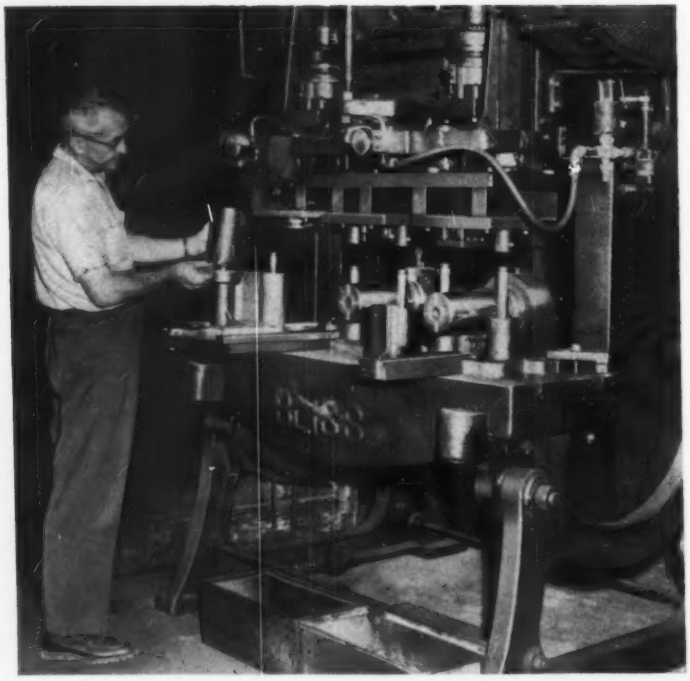


Fig. 7. Three-die setup on this press pierces all holes in addition to performing some of the required embossing. The bodies are advanced manually from one die to the next.

deep, with the inside diameter remaining 5 3/4 inches. Fig. 1 shows the cup as it appears not only after these first two steps, but also after several subsequent operations, two of which involve deeper draws. Trimming to length, washing, and reannealing precede them.

Both of the remaining draws are performed in a Bliss double-acting press, the first increasing the depth to 8 inches and forming the step at the bottom. In the last draw, the lower portion of the cup is given a slight straight taper and the top end is belled out to 5 1/4 inches in diameter in readiness for final trimming and beading. In addition, the depth is increased to 9 1/2 inches. Before final trimming, however, the bottom of the body is struck by embossing dies in a pneumatic drop press to form one circular rib and four short radial ribs for stiffening purposes.

Rolling of the lip bead around the top of the body is done in two stages, each performed on a lathe using rollers of proper contour as the spinning tools. Before each of these operations the bead area is annealed by local induction heating, Fig. 5. Such heating is rapid and results in only slight oxidation, which is subsequently removed by passivating and polishing. Beading is done to provide a smooth rim that is easily cleaned and of a diameter that makes a close fit with the apron of the cover. Nevertheless, a horn die in a press gives the neck its final sizing.

After bead polishing, the bodies are placed on mandrels that are rotated and reciprocated on Divine jacks, Fig. 6. The exterior surfaces are polished with 280-grit emery and grease on one machine, and with 320-grit emery and grease on a second machine, both using rag wheels. Similar machines then buff the surfaces to a high luster, using a Leerock compound.

A Bliss press, Fig. 7, is equipped with three sets of dies for piercing all holes. Percolator bodies pass through each of the three dies in succession. In the die at the left, a large hole is pierced to fit the heating well. The two remaining dies have horizontal horns over which the bodies are slipped. Punches in the first of these positions form two bosses, while another pierces the upper boss for the top handle screw. Still another punch forms a lower boss to which the head of a handle screw is subsequently welded.

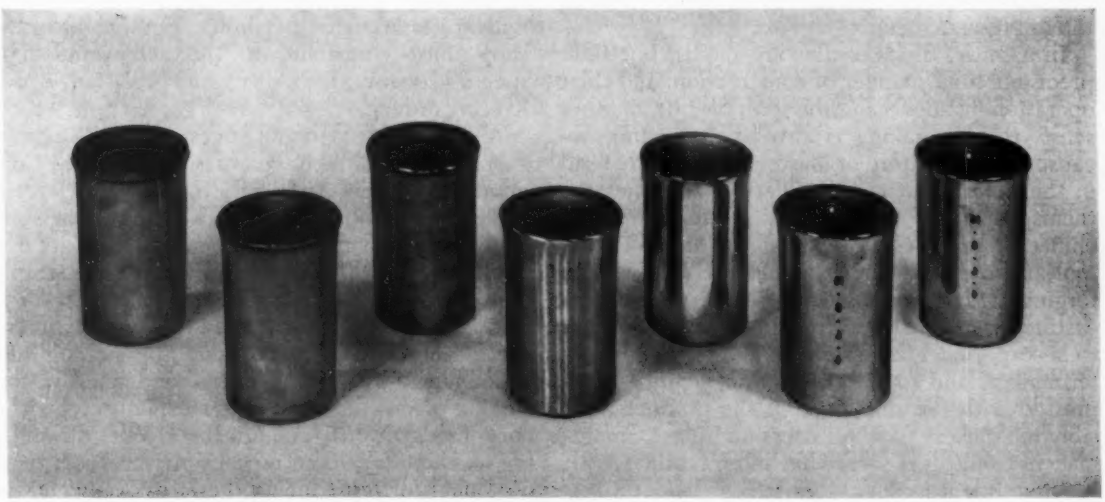
There are four punches in the third die. These are shaped like the numerals 4, 6, 8, and 10 and are located within the spout area. While indicating the number of cups to be brewed, they also form the openings through which coffee flows from the body into the spout. Another press and horn die are used to emboss the Universal loop design on the side of the body. Fig. 8 shows the body in successive stages of production after drawing has been completed.

With the completion of the percolator body a stamped stainless steel spout assembly is brazed in place using Eutec No. 157 wire. This yields a joint that matches the color of the steel. The hand-torch brazing is done in a clamping fixture and employs city gas and air. A flux containing glycerin and hydrochloric acid is applied with a brush. Subsequently, the spout is hand polished and buffed to match the body in finish.

The flat heads of three threaded studs are resistance-welded to the body—two on the bottom for fastening the thermostat assembly, and one at the boss for the lower handle fastening. Spout joints are then checked under light air pressure, using a soap solution to spot any porosity or leaks. A rotary scratch brush and No. 180 aluminum-oxide grit give the inside of the body a satin-like finish. This is done after hand dipping in a passivating solution, followed by rinsing, to remove any foreign matter, leaving the body ready for assembly.

A brass well forms the bottom of the percolator body. Silver-brazed outside, the well is a helix of copper tubing containing the heating element. This tubing is filled with powdered magnesium oxide that insulates the element electrically, but conducts heat rapidly.

Fig. 8. Percolator bodies as they appear after various operations subsequent to drawing and trimming. These include bead forming, polishing, and piercing.



LAURENCE W. COLLINS, Jr., Associate Editor

Die-Sinker Generates Forms Without a Model

Patternmaker, diemaker, toolmaker, modelmaker, molder—the investment caster's diemaker must wear many hats well. One of his most rapid and versatile tools is the universal pantograph die-sinker

THE TOOLROOMS of successful precision investment-casting plants have uncommonly versatile equipment and are staffed by resourceful personnel who get the most out of their equipment. The nature of the investment-casting business is such that the diemakers of the industry make dies for the injection molding of wax. However, the wax always has to be considered as though it were metal.

In a sense, the wax dies are molds, but their precision, their manner of construction, and their operation justifies using the term dies. In another sense, this diemaking is also partly casting because a metal pattern or master is frequently used in the building of the die. Parts of the dies are themselves cast, while other portions are machined from rolled brass, steel, or aluminum. A tool and diemaker, accustomed to stampings or forgings, would find some parts of the investment-casting diemaking practice familiar, others foreign to his experience. The same could be said of patternmakers and foundrymen, who would be impressed with the small size of the product. Possibly toolmakers for die casters and plastic moldmakers would feel somewhat more familiar with the investment caster's work.

The fact of the matter is that the investment-casting toolmaker's knowledge must combine backgrounds in many phases of patternmaking, mold making and diemaking. In addition, his work is so closely associated with the aircraft and missile hardware industries that he must also be expert in short-run die techniques for the sake of economy, meeting rapid engineering changes with speed and easy flexibility. Equipment in his shop must contribute to the achievement of speed, economy, flexibility, and precision in delivering orders.

A fine example of an investment-casting die shop is at the Brooklyn plant of the Arwood Corporation of New York City, one of the largest and most active in the field. The extreme flexibility of Arwood's die shop is enhanced by its use of the Deckel Model KF universal pantograph die-sinking machine, an import from West Germany. This equipment is used with many different attachments, one of them for sinking die components without a master, and another for making precise mold patterns mechanically, without a model. Oddly enough the Deckel die-sinking machine is seldom used by Arwood as a true die-sinker for reproducing the form of a wood or

Fig. 1. Roll-profiling attachment on Deckel universal pantograph die-sinker generates helical vanes guided by stylus in the track (right).

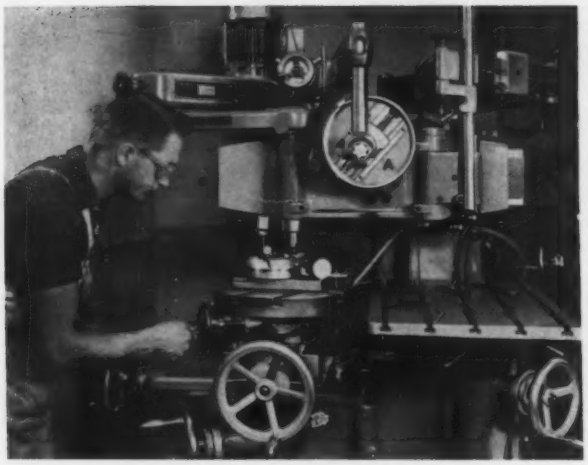
plaster model in metal. But it works continuously in other ways.

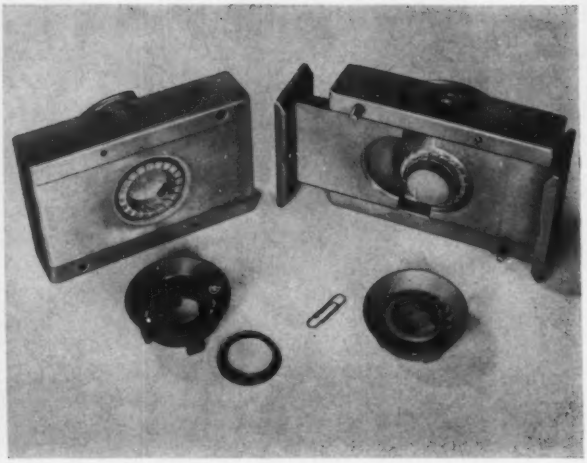
One arrangement used for generating die components without a model is called a roll-profiling attachment. The device bolts to the work-table, becoming the work-holder, Fig. 1. As suggested by its name, the attachment is principally intended for use in engraving embossing rolls with copy prepared in the flat. Arwood has equipped an arbor for the work-holder with index-plates. The work-piece is a hollow cylindrical die part whose end face has a series of deep helical slots perpendicular to the axis of the part, Fig. 4.

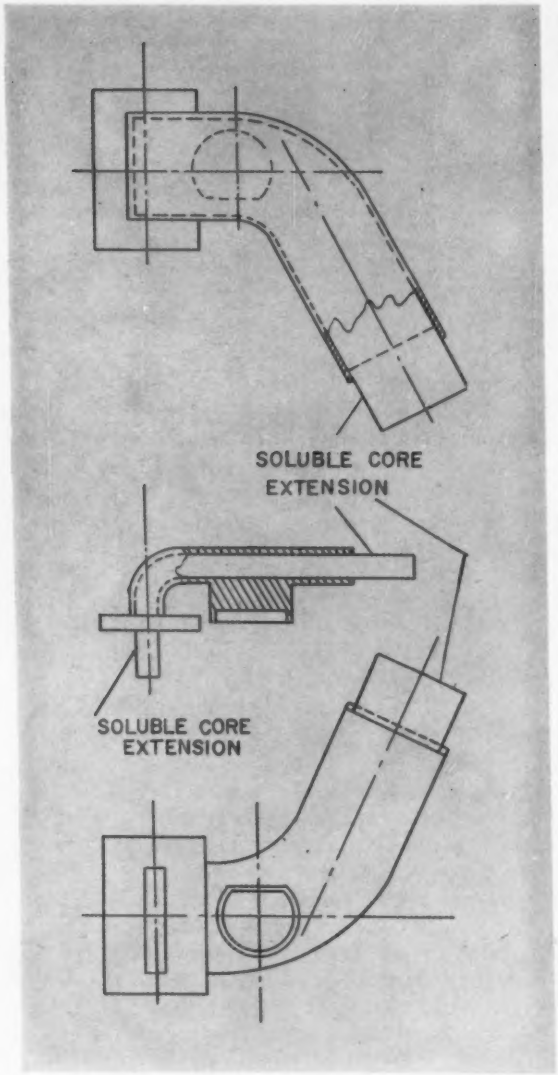
At the lower right in the illustration is the resulting investment casting in a heat-resistant stainless alloy. The casting is a jet-engine component with spiral vanes, called a swirler, whose function is to cause turbulence of the intake air around the fuel jets in the combustion turbine section. At the lower left are the wax vane and deflector components which, when wax-welded together, are invested to make the desired mold for the swirler casting. At the rear are the two halves of the wax-injection die shown open. The die section on the right is shown partly open to illustrate its complex structure and the method of opening movable slides for release of the wax investment pattern.

The roll-profiling attachment for the Deckel die-sinker makes the vane slots. It consists of a base which mounts to the regular knee type work-table of the machine (Fig. 1). This base carries a cross-slide on antifriction bearings. An angle-bracket bolted to the machine's spindle mount moves the cross-slide as the pantograph moves. With this linkage the cutter axis aligns with the radius of the work. The cross-slide has brackets that hold an arbor for cylindrical work. The axis of this arbor is at 90 degrees to the motion of the slide. Keyed on the rear end of the arbor shaft is a pinion gear. The gear meshes with a rack on a bracket that is fastened to the base of the attachment. Travel of the slide imparts rotation to the work-arbor through the rack and pinion.

The pantograph stylus follows a straight track slot clamped to the copyholder table. The length of the slot determines the distance the cutter will travel on the work axis. The angle at which the track is clamped to the copy table, plus the diameter of the arbor gear relative to the work diameter, together determine the helix angle of







the slots in the work. The operator cuts one slot at a time in the work by traversing the stylus the length of the track slot.

The same Deckel die-sinker is tooled in a different way by Arwood's diemakers to generate intricate patterns mechanically, Fig. 2, without a model. This operation is often called "cherrying." The roll-forming attachment is replaced by a rotary table and the stylus is not used. In place of the stylus a pattern-forming attachment is employed, Fig. 2. This accessory consists of a crank disc A that is mounted to turn on a hub bolted to the tool slide. The hinged mounting of the hub permits it to be tilted forward through 90 degrees of arc. The crank disc has a slide adjusted by a calibrated lead-screw. Mounted on this slide is a crankpin, linked to a universal joint, the fixed fork of which is the lower end of a vertical arm. At its top, the arm is held by a carrier bracket which clamps into a locating slot in the column of the machine. The machine, with this attachment, will mechanically generate any geometrically defined surfaces of a pattern, provided that the intersection between such surface and a plane is either an accurate line or the projection of a prism. By this method concave or convex cylindrical, conical, and pherical surfaces can be generated, regardless of their location in generally horizontal, vertical, or inclined planes.

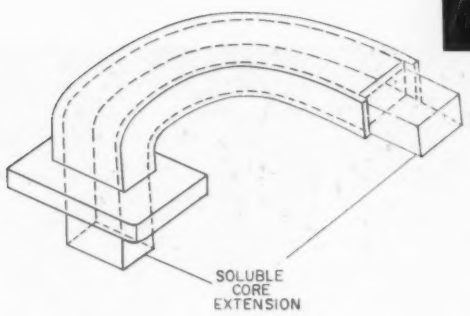
Similarly, it is also possible to radius-cut external (Fig. 3) as well as internal corners of bodies of revolution. In combination with a circular table mounted on this work-table, the cherrying attachment (Fig. 6) generates the master core pattern for a blower casting. The core pattern is profiled from the solid in aluminum. The work-blank is laid out with three different centers: one for the blower rotor, one for developing the spiral, and a third for the tangent exhaust duct.

Fig. 2. The eccentric created by the crank disc (A) of the pattern-forming attachment (left, facing page) causes the vertical pantograph to carry the tool point through an arc of preset radius.

Fig. 3. Details of wave guide (facing page, below) show necessity of generating core pattern using a soluble wax mold, as in Fig. 5, below.

Fig. 4. Jet-engine swirler (right, facing page) is investment-cast from assembled wax-pattern parts (lower left). Die halves, above, have helical slotted cores which must be movable in the die.

Fig. 5. Isometric sketch of a typical wave-guide component that is best produced using a soluble wax core.



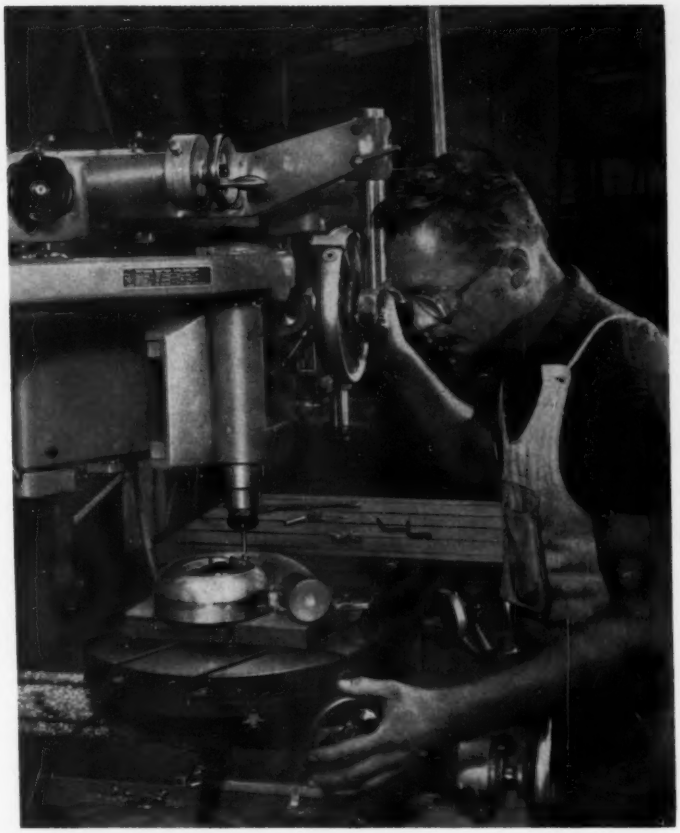


Fig. 6. Without a model, the pantograph die-sinker generates the spiral core-mold pattern (foreground) on the rotary table, using the pattern-forming attachment the toolmaker's right hand is holding.

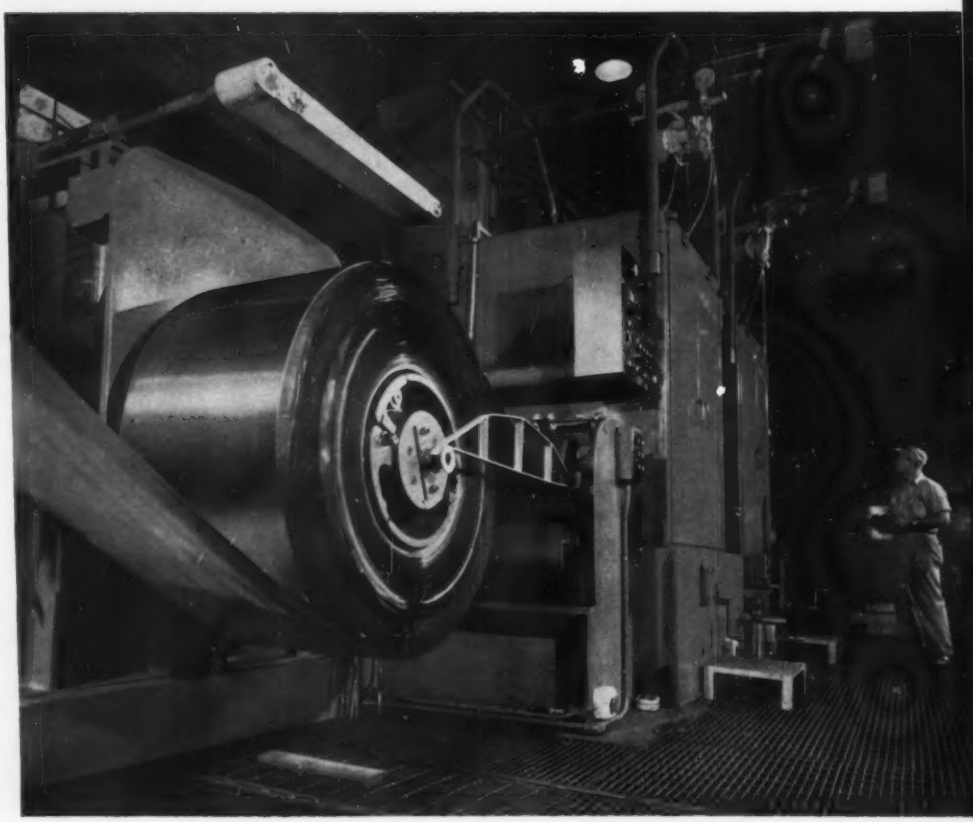
To impart three-dimensional motion to the cutter, the crankpin of the attachment is carefully moved to an eccentric position in its calibrated slide that will produce the desired convex radius. The operator manually rotates the crank disc, which causes the tool point to describe an arc. With the work clamped to the rotary table for turning, it can be easily seen that the compound spherical surfaces of the core can be generated with great accuracy. When the work center is moved, blending of the surfaces thus produced gives excellent symmetry to the parts with a minimum of hand blending needed. The knee of the machine is raised to feed the tool to the work for succeeding cuts. When one side of the core pattern is finished it is unbolted, turned over, and the other side machined.

For simple internal cavities or holes, a metal core is made around which an expendable pattern is formed when wax or plastic is injected into the die. However, for complicated internal configurations, such as that shown in Figs. 5 and 6, it is not practical to "pull" a metal core from the wax pattern. To obtain this core, another die is constructed which has the internal shape desired. A water-soluble wax is injected into this die, and the resultant pattern is used as the core around which regular investment wax is injected. The cored opening is then achieved, as before, by dissolving the investment wax pattern.

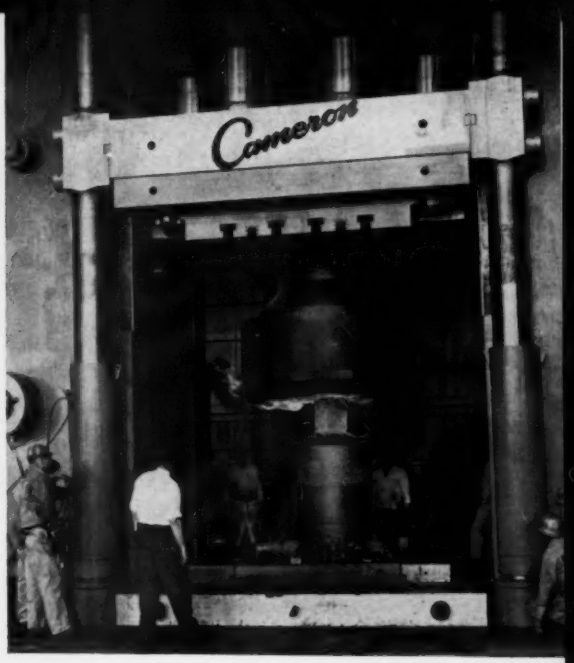
Advantages of the universal pantograph die-sinker are the many useful attachments that permit the machine to generate, duplicate, and engrave so many different intricate contours accurately and economically. Using the pantograph, size can be reduced or increased, and the form can be reversed. Tool costs are thereby reduced, and valuable lead time is saved. Delivery times are more predictable.

In Shops Around the Country

MODIFIED WELDER— Adaption of this d-c automatic fusion seam welder for a-c operation has doubled its usefulness to the Temco Electronics & Missiles Co., Dallas, Tex. Its previously restricted power supply ruled out welding of certain types and thicknesses of aluminum, as well as other metals. Using either alternating or direct current, the machine now yields a uniform bead at speeds up to 200 ipm.

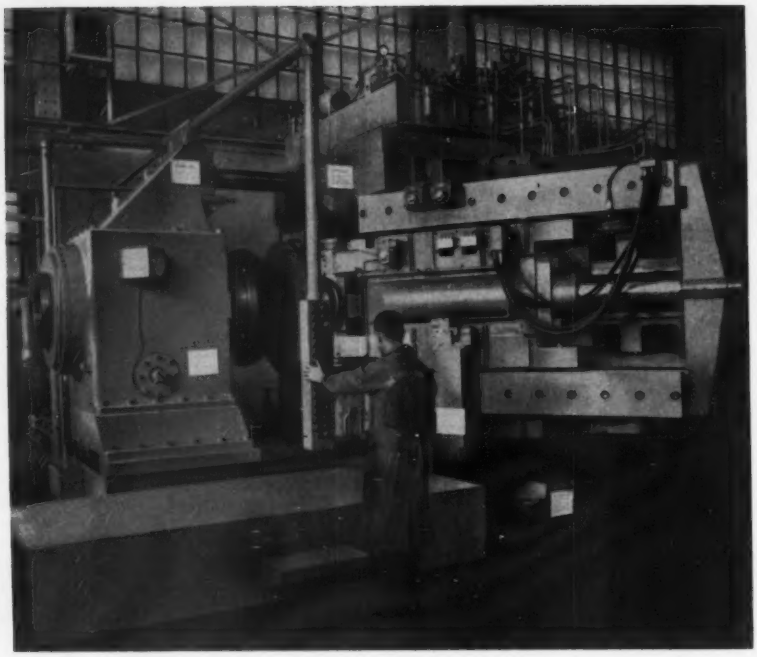


ABRASIVE MACHINING— Output end of a new abrasive-belt grinding line for producing "machined quality" stainless-steel strip at the Wallingford Steel Co., Wallingford, Conn. Protective paper is being fed to the coil from the extreme left. Thickness variation across the strip is held to 0.005 inch. Two machines comprising this wide-belt, oil grinding line are a joint development of Wallingford, the Behr-Manning Co., and the Hill-Acme Co.



CLOSED-DIE FORGING— A 20,000-ton squeeze can be applied by this closed-die forging press (above left) designed and built by Cameron Iron Works, Inc., Houston, Tex. Tipping the scales at more than 3,000,000 pounds, it is the largest privately owned closed-die forging press. The frame measures 50 feet in height and 31 feet in width. By removing the main piercing ram, extrusions up to 30 feet long and 56 inches in diameter can be produced. A small hollow-shaft forging has just been extruded, above right. Side rams of 5000-ton capacity are to be added. New throttling control provides an operating range of 0 to 400 fpm. Four 4500-gallon accumulator systems (right) are used—three air, one air and water.

ICBM to Have Shear-Formed Rocket Cases



Producing missiles such as the Minuteman requires the making of large-diameter shells reasonably and to exacting tolerances. To perform this task Lodge & Shipley has designed and built what is termed the largest horizontal shear-forming machine, the No. 70 dual-roller Floturn. It will handle parts 70 inches in diameter and 84 inches long, and is to be used by the Allison Division of General Motors to shear-form both cylindrical and conical shapes.

Parts can be produced from either flat or preformed blanks of mild steel, stainless steel, aluminum, brass, and other alloys. Although blank thickness can be as great as 1 1/4 inches (aluminum or brass), it can be reduced by 50 per cent in a single pass. Also, because of the design of the machine, it is possible to back-flow cylinders up to a length of 140 inches.

Each of two independently controlled roller slides can exert a force of 70,000 pounds on the work-piece. They are hydraulically actuated (under the control of individual templates) to present the two forming rollers at a 60-degree angle to the machine center line. The rollers can be adjusted for synchronized operation, or for operation with a deliberate offset so that one will work in advance of the other. Single-roller forming is also possible.

Among other features are retractable feed-rods which eliminate strain on the bed, a yieldable tailstock that continuously applies a blank-clamping force of 35,000 pounds while the carriage is feeding with a force of 105,000 pounds, and a work-piece stripper that uses the carriage feed cylinders as a power source.

Synchronized two-roll forming of conical shape under tracer control. Flat steel blank was 3/4 inch thick. Main motor of 150 hp drives 16-inch diameter hollow spindle.

MACHINERY'S Reference Section

Reliability Engineering, Its Impact on the Manufacturing Process

NEW ENGINEERING DIMENSION

The concept of reliability is rapidly growing in almost all industrial endeavors. AC Spark Plug, General Motors' pioneer in this new engineering-management technique, recognized its impact several years ago. With the advent of highly complex electromechanical devices, such as inertial guidance systems for missiles, reliability leaped to the forefront. It became the pivot on which operational success or failure rests. As a demonstration of AC management's support, a Reliability Division was created with staff-level authority as an aid to all engineering activities. This article, by one of AC Spark Plug Division's reliability engineers, William F. Chase, graphically explains some of the efforts undertaken to increase and maintain maximum reliability for the company's missile system products.

H. C. YOST
Director of Reliability

FEBRUARY 1961

Reliability Engineering, Its Impact on the Manufacturing Process

WILLIAM F. CHASE
AC Spark Plug Division, General Motors Corporation
Milwaukee, Wis.

THE DEVELOPMENT of equipment for the military, in recent years, has introduced a new concept termed Reliability. In general, reliability adds the dimension of "time" to the requirements for a product. In practice, reliability is the new science that engineers the successful performance of a space shoot, where every one of the 300,000 components of a missile works just right throughout an entire mission.

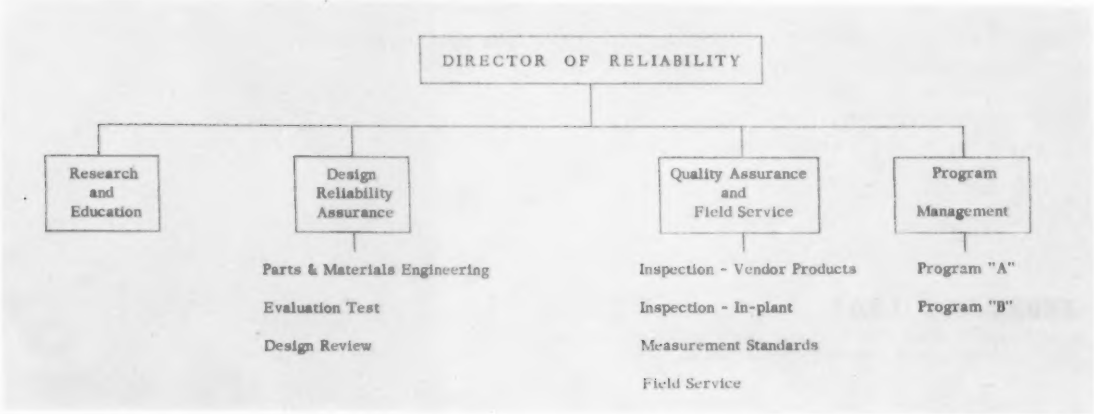
The requirement that manufactured products have the capability of performing their missions has placed a new specification on contractors of military equipment. This performance specification, in addition to all the previous measurements covering the function of equipment, has generated a new area in manufacturing science called Reliability Engineering. Many companies still function without any reliability department. In such cases the responsibility for meeting the requirement that "the equipment perform in a satisfactory manner throughout its mission" is handled by the engineering department. The inspection, or quality-control, functions of the organization work to assure that the reliability requirements are met in production.

In the above statement it appears, at first glance, that the responsibility for meeting specifications covering reliability lies in only a few departments. This is far from the truth. In reality, responsibility for reliability rests with everyone in the plant, whether their salaries are charged to direct-manufacturing process or are considered a part of burden costs. While this is a simple statement to make, it is another matter to make and keep all personnel aware of the obligation assumed with the acceptance of the contract.

The management of AC Spark Plug Division of the General Motors Corporation, at about the time its bid was being prepared for the Titan Missile Contract, decided that reliability was not just an ordinary engineering function. It reasoned that the whole plant operation was affected. Therefore, it was decided that a separate division for reliability must be established.

One might ask the question, "What can such a group do that the other cannot do?" The answer is fairly simple. There is now one group, specifically Reliability, working full time to assure that the product will function without failure for the life of the mission. This group is aware

Fig. 1. Organization structure chart of AC Spark Plug Division of General Motors Corporation clearly demonstrates that the reliability-engineering concept is top-level policy with broad and penetrating influence.



of the requirements of the functional design faced by the engineers and designers. It is aware of the schedules of the manufacturing group, and of the pressure of delivery and costs faced by the purchasing department. But none of these factors prevent the Reliability Division from continually asking, "Will the decisions we make increase the likelihood that our product will meet its objectives?" The answer to this question affects:

Design—Engineering has the responsibility for the functional design, including the selection of materials and components.

Tooling—Production engineering has the responsibility for providing the tooling for manufacturing production.

Manufacturing—Manufacturing must produce assemblies to meet a schedule and must fulfill the requirements of the drawings and specifications.

Quality Control—Inspection assures that production has met the requirements of the drawings and specifications.

Use—Field Service assures proper maintenance and use.

Management—Program managers assure that special manufacturing requirements are satisfied. Many of the newer products and assemblies involve special consideration for workplace cleanliness, special low-moisture-content atmospheres, special employe training, methods development, and material selection that are beyond the scope and knowledge of normal plant operatives. Reliability engineering, through integrated study and experiment, can develop adequate methods and set feasible standards.

A reliability organization may assume many forms. However, in a number of recent reports on the subject, a basic organization pattern has emerged to meet the needs of military contracts. The organization structure at AC Spark Plug is shown in Fig. 1.

Design Reliability Assurance

The assurance that the design has the inherent reliability required to meet the contract involves a number of departments:

Parts and Materials Engineering Department

Parts Specialists—So large is the number and variety of electronic, electrical, and electromechanical parts on the market today that it is almost impossible for the designer to be familiar with all of the selections of components which he might require for his product. For a particular application, he may have a choice of six different components, from at least as many vendors, any one of which would satisfy the functional design.

ANALYSIS OF RELIABILITY DEGRADATION

Part Identification: _____ **Mil. Spec.** ____ **Date** _____

Source of Failure	Percentage	
	Sub-Total	Total
Engineering Design:		
Electrical	30	
Mechanical	10	40
Manufacturing		20
Field Operation		30
Other Modes:		
Protection	8	
Packaging	2	10
Total		100

Fig. 2. Failures of typical electric components are proportioned among modes as charted in this list.

At this point, the parts specialist comes to the aid of the designer. From his knowledge—substantiated by test data, failure reports, and similar records—the parts specialist can recommend a component or selection of components that will not only function, but which will also be rated at sufficient "mean-time-between failures" (M.T.B.F.), to insure that the mission-time requirement can also be met.

Vendor Liaison and Parts Improvement—Since the specifications for most new weapon systems require an improvement in the "state of the art," it is essential that contractors assist vendors in improving their products. Thus, the vendor increases the inherent reliability of the elements he is supplying. A group of reliability engineers works continually in this area at AC Spark Plug. As state-of-the-art improvements are made, they are tested and released to the designers for consideration in new product designs.

Materials Engineers—In the selection and application of materials the designer can depend on reliability specialists. The latter aid the designer in the selection and application of materials, and in devising proper material processing to meet the maximum requirements of the design.

Parts and Materials Standards—The responsibility for getting parts information into the hands of the designers and engineers rests in the standards group at AC Spark Plug. As soon as a new part or material is tested and found acceptable, working data is developed into a standard and put either into the "Instrument Design Manual" or into an "Electronic Parts Selection Manual."

With the data supplied in these manuals, the designer can check the adequacy of his design.

Evaluation Test Department

Test Planning—In order to obtain the maximum amount of benefit of data from a test or series of tests, an adequate evaluation program or plan must be devised. Thus, when the engineers require tests of prototype products, it is possible by the scientific planning of such tests to obtain not only the key results needed, but to supply valuable auxiliary data on parts, methods, and equipment. Of importance equal to proving that a piece of equipment will function under various environments is the verification of the reliability prediction (M.T.B.F.). For these many results, it is important that proper procedures be planned before the tests start.

Test Engineering—All facilities for testing environment, life expectancy, vibration resistance, and shock tolerance are under the direction of the director of reliability. Using these facilities in accord with the test plan, tests conducted on prototypes and products (either to prove the design or to verify the reliability estimate) yield M.T.B.F. data useful to the parts and specifications group.

Data Analysis—Methods of statistical analysis are used to collate, organize, and present the results of test programs. Upon completion of the analyses, the reliability group disseminates the data. In-plant operating time and failure reports combined with those from the field are used by this group to establish M.T.B.F. data on both parts and equipment.

Design-Review Department

From surveys made by the military departments, electronic equipment failures to operate can be proportioned as indicated in Fig. 2. The parts and materials engineering group is contin-

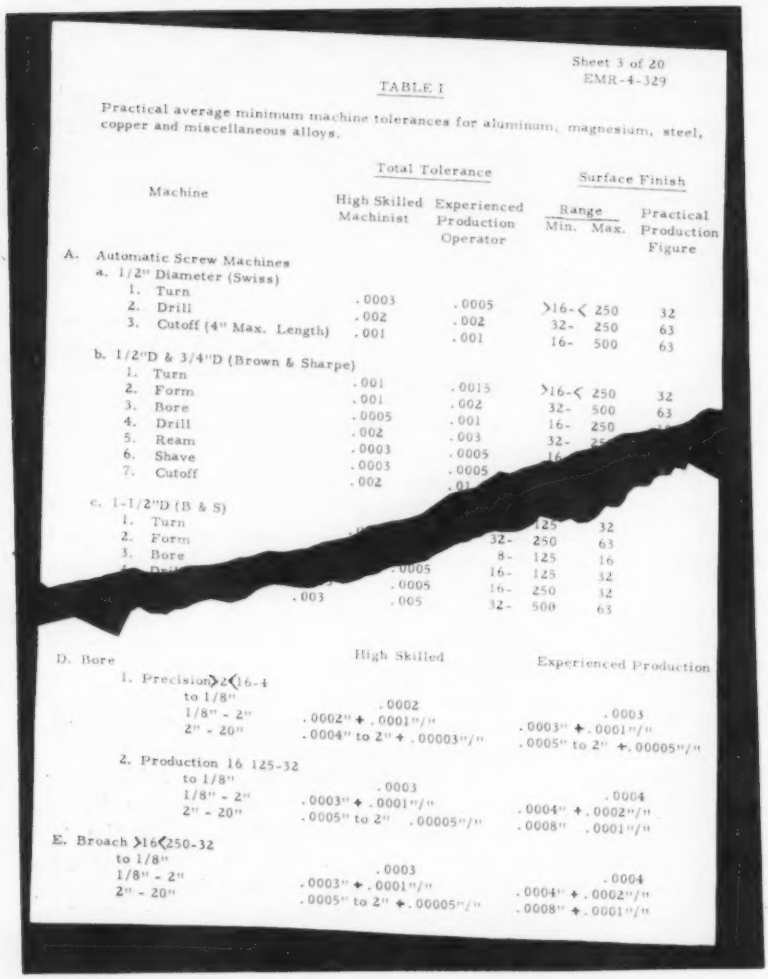


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TABLE I

Practical average minimum machine tolerances for aluminum, magnesium, steel, copper and miscellaneous alloys.

Machine	Total Tolerance: High Skilled Machinist	Total Tolerance: Experienced Production Operator	Surface Finish: Range Min.	Surface Finish: Range Max.	Surface Finish: Practical Production Figure
A. Automatic Screw Machines					
a. 1/2" Diameter (Swiss)					
1. Turn	.0003	.0005	>16-<	250	32
2. Drill	.002	.002	32-	250	63
3. Cutoff (4" Max. Length)	.001	.001	16-	500	63
b. 1/2"D & 3/4"D (Brown & Sharpe)					
1. Turn	.001	.0015	>16-<	250	32
2. Form	.001	.002	32-	500	63
3. Bore	.0005	.001	16-	250	
4. Drill	.002	.003	32-		
5. Ream	.0003	.0005	16-		
6. Shave	.0003	.0005			
7. Cutoff	.002	.01			
c. 1-1/2"D (B & S)					
1. Turn				125	32
2. Form			32-	250	63
3. Bore			8-	125	16
		.0005	16-	125	32
	.003	.0005	16-	250	32
		.005	32-	500	63

D. Bore	High Skilled	Experienced Production
1. Precision >2<16-4		
to 1/8"	.0002	.0003
1/8" - 2"	.0002" + .0001"/"	.0003" + .0001"/"
2" - 20"	.0004" to 2" + .00003"/"	.0005" to 2" + .00005"/"
2. Production 16 125-32		
to 1/8"	.0003	.0004
1/8" - 2"	.0003" + .0001"/"	.0004" + .0002"/"
2" - 20"	.0005" to 2" .00005"/"	.0008" .0001"/"
E. Broach >16<250-32		
to 1/8"	.0003	.0004
1/8" - 2"	.0003" + .0001"/"	.0004" + .0002"/"
2" - 20"	.0005" to 2" + .00005"/"	.0008" + .0001"/"

Fig. 3. Generalities are being applied to the performance characteristics of production machine tools and classes of operator, as is shown by this portion of a reliability-engineering survey report of gear-hobber accuracy.

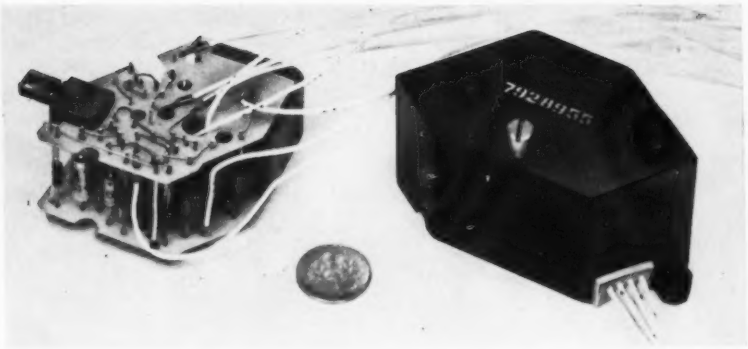


Fig. 4. Welded electronic module appears on the left, before being molded into epoxy-resin capsule. Shown on the right is the module encapsulated, alongside a dime for size comparison of this control element.

ually trying to give the designer a better matched, more compatible group of parts for assembly. But without the proper application of this better set of parts, the over-all reliability of the equipment will not be improved. Thus it is that the Design-Review Department is staffed by experienced engineers whose main function is to assist the designers in the analysis of their designs so that reliability requirements can be met.

The design-review group has specialists in the areas of systems, electronics, stress and vibration, electromechanical devices, human factors, and process evaluation.

Formal reliability reviews are made prior to product release for production. These verify that reliability specifications will be met.

Quality Assurance and Field Service

Referring again to Fig. 2, the degradation of the inherent reliability of the design during manufacturing and field operations requires that special effort be directed in these areas.

Inspection Department (Vendor Products)

Since considerable effort is expended to specify parts of the highest quality, it is necessary to inspect incoming items to insure that these specifications are met. Besides the normal inspections, certain parts, deemed critical in nature, are subjected to extended performance testing.

Inspection Department (In-Plant)

Manufacturing has a tremendous responsibility to produce parts conforming to the prints and specifications provided by engineering. While no one can "inspect" quality into the parts, good inspection can prevent unqualified parts from being built into the product and eventually delivered to the customer. Thus AC in-plant inspection continuously works to achieve this end.

Measurement Standards Department

Equally important to the design of a part are the tools required to produce it. These tools, in turn, depend on certain standards of measurement to check their accuracy. A measurement standards department was created within the AC reliability organization to provide this service.

Field Service

A number of departments are concerned with the equipment in the field. These groups provide training and personnel for maintenance and product support. Through a system of field failure reporting, an analysis of the causes for equipment failures is recorded and appropriate corrective action undertaken.

Program Management

Today the nature and complexity of most military programs require the establishment of a reliability program manager. This manager's function is to coordinate the activities of reliability with those of the project office of a given project. The reliability program manager sets the schedules needed to fulfill the requirements of the contract with respect to the reliability of the product to be manufactured.

Research and Education

Reliability is every employe's business. In order to continually keep all employes aware of their responsibilities for reliability, at AC, a research and education staff prepares lectures, training courses, and other programs. The exchange of information with other contractors and the various military organizations is also a responsibility of this group. To keep up with the increased demands for reliability, the R & E staff continually investigates new reliability methods.

Reliability-Engineering Programs and Machine Tool Builders

How does a customer's reliability organization affect machine tool builders, tool and manufacturing engineers? Today the military is faced

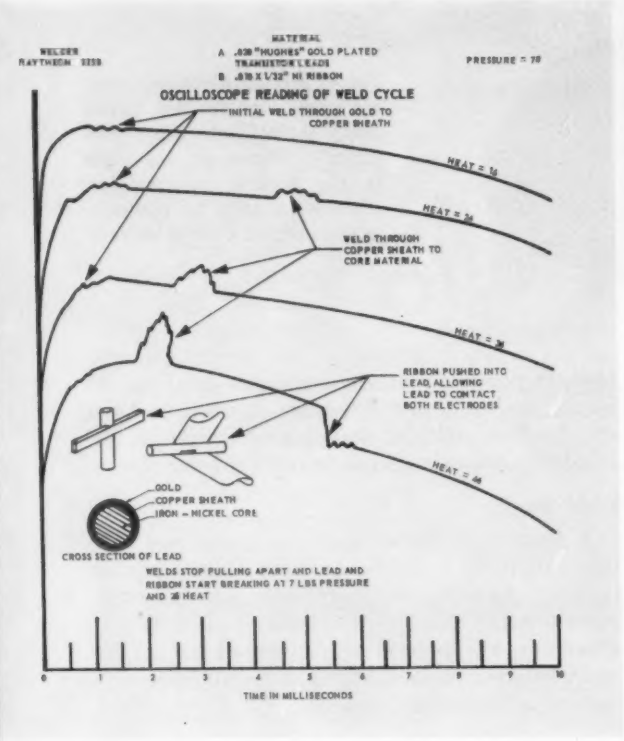

WELDER
RAYTHEON 1220
MATERIAL
A .020 "HUGHES" GOLD PLATED TRANSISTOR LEADS
B .010 X 1/32" NI RIBBON
PRESSURE = 7#
OSCILLOSCOPE READING OF WELD CYCLE
INITIAL WELD THROUGH GOLD TO COPPER SHEATH
HEAT = 14
HEAT = 24
WELD THROUGH COPPER SHEATH TO CORE MATERIAL
HEAT = 34
RIBBON PUSHED INTO LEAD, ALLOWING LEAD TO CONTACT BOTH ELECTRODES
HEAT = 44
GOLD
COPPER SHEATH
IRON – NICKEL CORE
CROSS SECTION OF LEAD
WELDS STOP PULLING APART AND LEAD AND RIBBON START BREAKING AT 7 LBS PRESSURE AND 25 HEAT
0 1 2 3 4 5 6 7 8 9 10
TIME IN MILLISECONDS

Fig. 5. Change-over from soldering to the spot welding of hookup wires in an electronic chassis resulted in a major research engineering project, some of whose results were evaluated on these oscilloscope graphs.

with the problems of providing a missile that can travel a mission of 5000 miles or more to hit a target with pin-point accuracy. The National Space Agency plans to put a man into space—and *get him back*. The old axiom, "You can't inspect quality into a part," is being used so often that it is becoming threadbare. Inspection alone cannot achieve such tremendous goals as getting a man into space and back. Essentially, the implication is that the normal manufacturing effort put forth in the past is not good enough. In fact, it will require not just a small—or even a moderate—improvement, but a tremendous effort. It means that the little "bugs" previously left unquestioned in a product now have to be thoroughly investigated. It means that these investigations have to be thoroughly documented and their recommendations for improvement followed with meticulous precision. Only this way will we get the man in the space capsule back—alive.

To the machine tool builder, reliability engineering means he is going to be asked to provide machines and tools capable of performing to extreme accuracies. The requirement of launching a missile 5000 miles to land within a 5-square-mile area might be assumed to be only an accuracy of 0.001 inch. The guidance equipment for this mission is built up of thousands of parts. Thus, because of tolerance stack-up, it is obvious that the requirements on individual parts have to be much tighter. The engineer continually reiterates his need for better gears, better bearings, better electronic components. This is the challenge to the machine tool builder, the tool engineer, and the manufacturing engineer.

Tolerance Limits in Production

One of the biggest problems faced today is to inform the designer as to the degree of accuracy he can expect from manufacturing equipment. For one of its projects, that section of the Reliability Division working with Tooling and Manufacturing engineers surveyed all of the equipment in AC Spark Plug plants. Management learned that much of the equipment supplied as standard by machine tool builders had to be reworked upon arrival to perform to a higher accuracy requirement. Information on machine tool accuracy is therefore of basic importance to designers. The results of one of these surveys were published in the form of a report, a portion of which is reproduced in Fig. 3.

For example, if a designer requires a hole 4.25 inches in diameter, this report tells him that in a precision boring operation in production he could expect a tolerance of:

$$0.0005 + 0.00005\ (4.25 - 2) = 0.00061 \text{ inch}$$

If he requires a much tighter dimensional tolerance than this, he has to go to selective assembly or accept a higher rejection rate in production. Another portion of Fig. 3 deals with the surface finish that reasonably can be expected in a boring operation.

One of the most common mistakes of an inexperienced designer is to call for a comparatively fine surface-finish requirement and a nominal part-print tolerance on the assumption that in doing so, he hasn't presented a serious problem to production. Actually, by doing this, he has greatly increased the cost of the part by setting an excessively hard-to-produce surface-finish requirement. Very often in these cases, it has been found that by setting a closer machining tolerance, the designer could have relaxed his finish specification with the result that the part could be made much more economically.

Welded Electronic Modules

An illustration of the team effort exerted to bring a new reliability concept into a state of reality is one that was required to produce

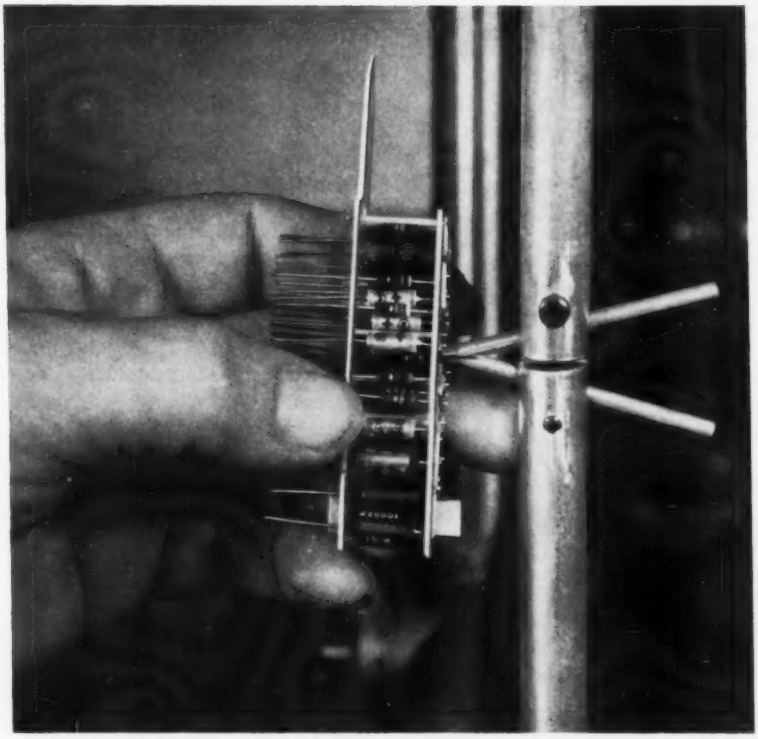


Fig. 6. Microminiature electronic assembly has its hookup wires welded instead of soldered. The Raytheon spot welder replaces the customary solder and soldering iron. Change-over to welding created a major project for vendors who had to be persuaded to furnish components with wire leads that could be welded with highly reliable end results.

welded electronic-system modules at the division's Milwaukee plant.

Engineers in the missile industry have long been faced with the problems of reducing the weight and size of components. While groups have been experimenting with microminiature modules for several years, the state of the art is such that very little is really known of the reliability of such assemblies. On the other hand, many standard electronic components—such as resistors, capacitors, diodes, and transistors—have fairly well-established failure-rate data available. An approach to the microminiaturization problem at AC Spark Plug was, then, to develop a module using reliability-established parts in an effort to reduce the weight and size of the product. In planning the various approaches to the problem, the proposal of welding component wire leads was suggested as a method of eliminating conventional soldered joints. The reduction in weight (elimination of the solder) and the use of high-density packaging resulting from welding were reasons in favor of this new technique in wiring an electronic circuit.

However, it was realized that while eliminating some of the previous sources of unreliability, the new welded design was introducing a whole new group of variables, each of which must be thoroughly investigated, tested, and documented to prove its merit. Vendors in previous programs were, in general, only required to supply components with wire leads that were solderable. Now it was discovered that wire leads that were solderable were not suitable for the proposed resistance welding. An investigation into the capabilities of welding the leads on all of the parts required in the program had to be undertaken, Fig. 4. AC's manufacturing development engineers undertook an extensive investigation into:

1. Welding machines;
2. Wire-lead materials;
3. Welding machine controls;
4. Welding machine control settings;
5. Tests.

Vendors cooperated by sending in thousands of samples of their wire-lead materials and dummy components. After determination of all the welding machine variables and determining the best control settings, the reliability engineers of the test and evaluation section conducted large sample-size weld tests, Fig. 5. These samples were subjected to environmental tests to assure weld reliability. Thus, thousands of welds on many materials were made, tested, and the results documented, Fig. 6.

At the same time, investigations were being made to determine optimum encapsulating methods for these electronic assemblies. The use of

epoxy resins for encapsulation improved reliability by showing the best resistance to vibration and humidity.

Plastics engineers faced the problems of providing an encapsulating material to conform to the following:

1. Low shrinkage during the cure;
2. Low specific gravity;
3. Low coefficient of thermal expansion;
4. Limited cure temperature;
5. Usable pot life.

As more promising encapsulating materials were found, test modules were made to determine their effects on components. Hundreds of components were used to determine the effects of welding, encapsulation, and environment (Fig. 7).

Manufacturing engineers prepared training courses for the operators required. Since these new methods required a high degree of operator skill, many hours of training were needed to acquaint an operator with his responsibility and the requirements for achieving a high degree of reliability.

This reliability program at AC Spark Plug is still in its infancy. The reliability-engineering department is continually investigating means to improve the life of the product. Thus, as the months go by, it expects to find solutions to some of the following problems:

1. More uniformly weldable wire-lead materials on vendors' components. This requires that AC Spark Plug's parts specialists work with its suppliers to provide a line of components suitable for welded assembly.

2. Semiautomatic welding machines that reduce the need for operator skill.

3. Development of nondestructive tests for welds.

4. Smaller, lighter-weight components.

Gears

Many of the products manufactured by AC Spark Plug Division, Milwaukee, require the use

Fig. 7. Spot-welding an electronic hookup in a microminiature electronic amplifier chassis uses miniaturized equipment.

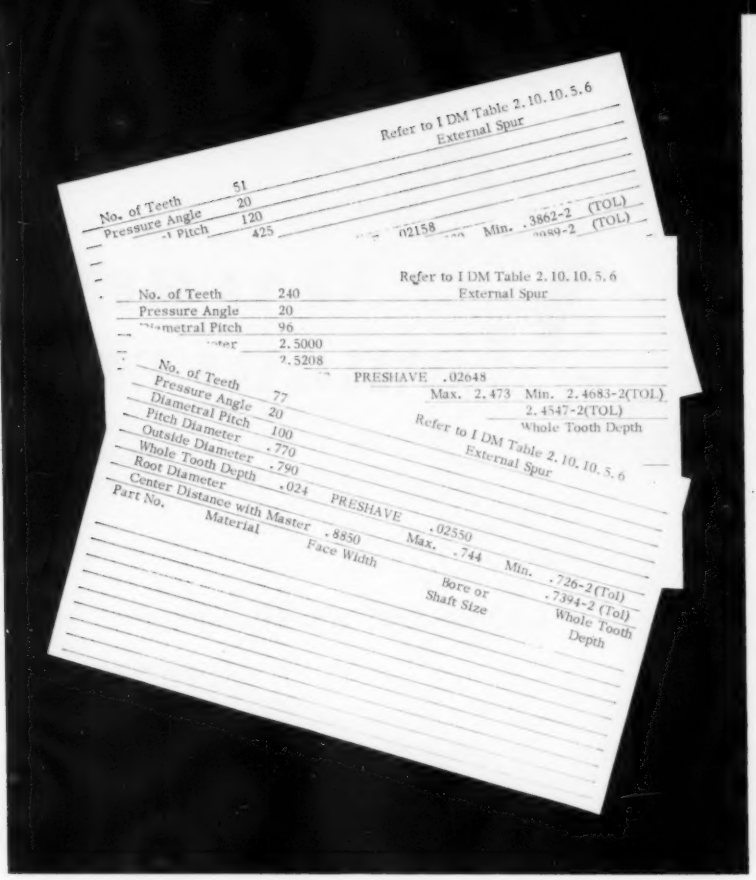


Fig. 8. Gear cards developed by the Reliability Division for designers list manufacturing feasibility of fine-pitch gears used in missile hardware at AC Spark Plug.

of fine-pitch precision gears in large numbers. Immediately after World War II, requirements for gears with diametral pitches of 100 or higher were uncommon. Today, in inertial guidance and navigational computer mechanisms such gears have become commonplace. While Class I, II, and III precision gears are specified in limited applications, the demands of the designers still trend toward greater accuracy.

This requirement for ever-closer dimensional tolerances has taxed the ability of tool engineers to provide tools and machines to generate gears to meet the specifications. Almost every gear-hobbing machine in the AC Spark Plug plant has been rebuilt to perform to a higher degree of accuracy than that provided by the machinery manufacturer. In order to aid the designer, the Reliability Division set up a series of gear specification cards, Fig. 8. These gear cards cover all the fine-tooth gears manufactured at the plant and include the dimensions and tolerances for any particular gear.

Beryllium

Beryllium, because of its light weight, is being used more and more in the construction of gyros. This metal, because of its toxicity and pyrophoric qualities, presents a whole new series of reliability problems to tool and manufacturing engineers. The problems of machining, forming, cleaning, joining, and finishing all require solutions by production personnel that must be adaptable without any degradation of the inherent reliability of the original design. Machine tools must have special dust collectors.

The Future

The problems in reliability engineering described in the foregoing examples represent only a modest few of those daily confronting tool and manufacturing engineers at the AC Spark Plug Division. The manufacturers of tools and machines can expect to be asked to supply more and more special, higher-precision equipment than ever before. The role of the reliability engineer will grow in scope and responsibility with each new project undertaken. One only has to look at the financial pages of any newspaper to comprehend the increase and growth of new companies making products that didn't exist ten years ago, especially in controls, instrumentation, electronics, and electromechanical devices. With the truly fantastic expansion of these new concepts and new products, the application of the reliability requirement, "It must have the capability of completing its mission," becomes more and more insistent. Add to this growth the tremendous cost of these projects, and it becomes apparent why government procurement officials and management are insisting on proved reliability.

MACHINERY'S PROBLEM CLINIC

Mathematical problems in shop work and tool design submitted by readers of MACHINERY

Edited by HENRY H. RYFFEL

Calculating the Dimensions of a Flat Spring

WILLIAM W. JOHNSON, Cleveland, Ohio

In the design of the flat spring shown in Fig. 1, it was required to find the dimensions r and m.

Solution:

From Fig. 2, we get

1. $r - r\cos\alpha = \frac{19}{64}$

2. $r - r\cos\theta = \frac{11}{64}$

3. $r(\alpha + \theta) = 2\ 1/2$

Dividing (3) by (1),

4. $\frac{\alpha + \theta}{1 - \cos\alpha} = \frac{160}{19}$

$1 - \cos\alpha = 2\sin^2\frac{\alpha}{2}$, then

$\alpha + \theta = \frac{320}{19}\sin^2\frac{\alpha}{2}$

Dividing (2) by (1)

5. $\frac{1 - \cos\theta}{1 - \cos\alpha} = \frac{11}{19} = \frac{2\sin^2\frac{\theta}{2}}{2\sin^2\frac{\alpha}{2}}$, or

$\sin\frac{\theta}{2} = \sqrt{\frac{11}{19}}\sin\frac{\alpha}{2}$

Let $K = \sqrt{\frac{11}{19}}$; then

$\theta = 2\sin^{-1}\left(K\sin\frac{\alpha}{2}\right)$

By (4), we get

$\alpha + 2\sin^{-1}\left(K\sin\frac{\alpha}{2}\right) = \frac{320}{19}\sin^2\frac{\alpha}{2}$

6. Let $x = \sin\frac{\alpha}{2}$, then

$\sin^{-1}x + \sin^{-1}Kx = \frac{160}{19}x^2$

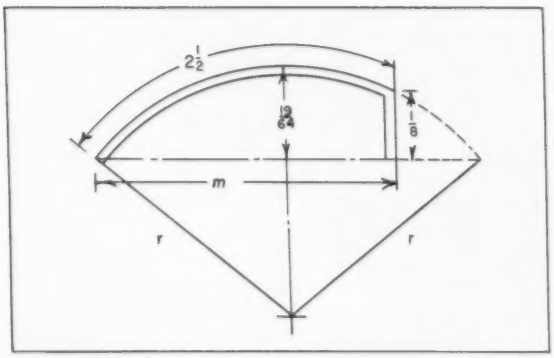
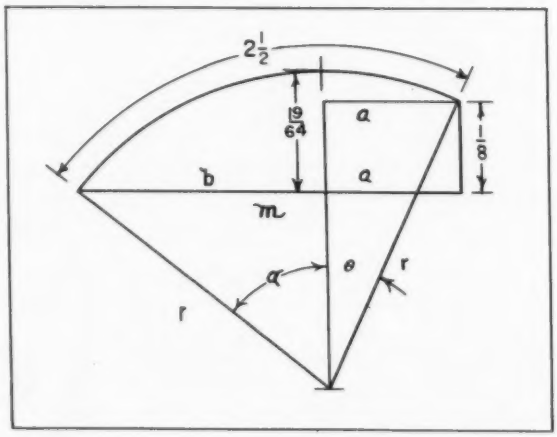


Fig. 1. Curved flat spring for which dimension (m) and radius (r) are required.

Fig. 2. Construction used in solving for (m) and (r).



This equation may be solved by the method of successive approximations. When x is small, $\sin^{-1} x = x + \frac{x^3}{6} + \frac{3x^5}{40}$. When x is small, we may use $\sin^{-1} x = x$ and $\sin^{-1} Kx = Kx$. Then by (6), we get

$$1 + K = \frac{160}{19} x$$

$$K = \sqrt{\frac{11}{19}} = 0.76$$

Then,

$$1 + \frac{76}{100} = \frac{160}{19} x$$

$$x = \frac{176 \times 19}{100 \times 160} = \frac{209}{1000}$$

$x = 0.209$ or $\sin \frac{\alpha}{2} = x = 0.209$

$$\frac{\alpha}{2} = 12° 3' 50''$$

$$\alpha = 24° 7' 40''$$

$$\sin \frac{\theta}{2} = \sqrt{\frac{11}{19}} \sin \frac{\alpha}{2} = 0.76 \times 0.209 = 0.1584$$

$$\frac{\theta}{2} = 9° 8' 23''$$

$$\theta = 18° 16' 46''$$

$\alpha + \theta = 42° 24' 26'' = 0.740146$ radians

By (3) $r = \frac{2.5}{\alpha + \theta} = \frac{2.5}{0.740146} = 3.3777$

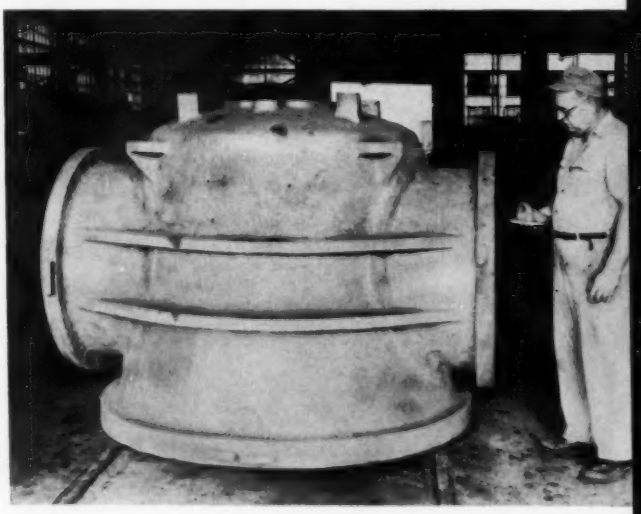
$b = r \sin \alpha = 3.3777 \sin 24° 7' 40''$
$= 1.3807$
$a = r \sin \theta = 3.3777 \sin 18° 16' 46''$
$= 1.0594$
$m = a + b = 2.4401$

Birdsboro Converts Foundry to Electric Steel Production

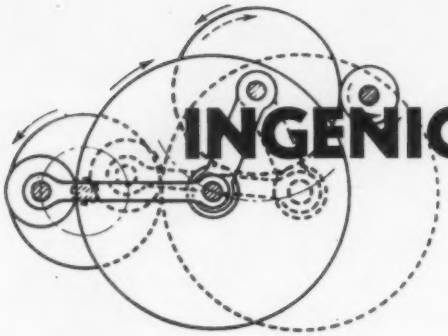
Climaxing a five-year modernization and expansion program that has totaled $1,750,000, the Birdsboro Corporation, Birdsboro, Pa., has fully converted its steel foundry production from acid open-hearth furnaces to the basic electric melting process. Final transition was accomplished with the recent installation of two new electric arc furnaces. Now, with a total of three furnaces (all of different sizes), the company can melt up to 300 tons of electric steel per day and can produce all foundry type stainless- and high-alloy steels.

Both the molding and core shops have been expanded and reorganized to permit efficient, continuous flow of work from molding at one end of the foundry to rail shipment (to the cleaning department) from the other end. The company can now turn out a wide variety of castings—small, medium, and large—ranging in size from 50 to 75,000 pounds. In actual practice, depending on the design and linear measurements of the casting, this upper limit can be stretched to 100,000 pounds. Other major additions include two new high-temperature, car-bottom type heat-treating furnaces of 50- and 100-ton capacities; recirculating-water quench facilities with 15,000-pound capacity; a four-compartment core oven; an automatic shakeout machine; a stationary sand slinger; and a 6-ton mold roll-over draw machine.

Work is now under way to remove the foundry's three open-hearth furnaces. In their place, additional production type mold-producing equipment will be installed. In operation, this equipment is expected to increase the foundry's miscellaneous casting capacity from 1050 to 1250 tons per month. The company's capacity for rolls and railroad specialties will be unaffected.



Production flexibility of the Birdsboro foundry is exemplified by these two castings—a 10-pound bracket and a 14,000-pound valve body.



INGENIOUS MECHANISMS

Mechanisms selected by experienced machine designers as typical examples applicable in the construction of automatic machines and other devices

Moving Supports for Long Boring-Bar

H. B. SCHELL, Brooklyn, N. Y.

When large forged gun barrels are bored, the boring-bar may run as long as 70 feet. Such a long bar may easily bend of its own weight. The consequence is a bore that will weave eccentrically in some sections, or be out of round. To eliminate these inaccuracies an effective traveling support system, Fig. 1, has been devised at the plant where the writer is employed.

The boring-bar is supported at three intermediate points on the tailstock by traveling supports *X*, *Y*, and Z. The left-hand support *W* has no movement. The housing *C* contains the motor and the necessary gears and controls to feed the bar to the left into the bore at the desired rate. The right-hand end of the boring-bar is attached to this drive. The three intermediate supports move in the direction of the boring-bar feed at speeds arranged so that they are at all times equally spaced between the support *W* and housing *C*.

It will be noted that the clear space between supports *W* and *X* is one-fourth of the sum of the clear spaces between *W* and *C*. Consequently, support *X* should move one-fourth of the speed

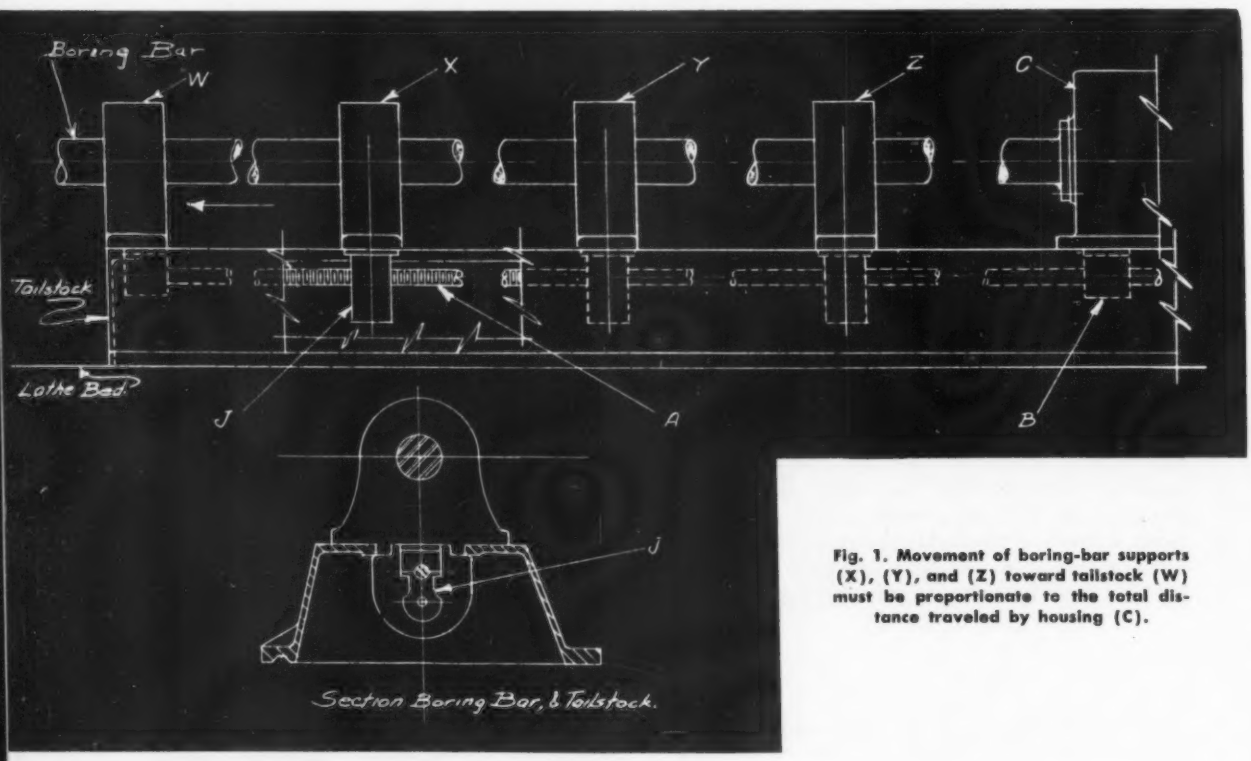


Fig. 1. Movement of boring-bar supports (X), (Y), and (Z) toward tailstock (W) must be proportionate to the total distance traveled by housing (C).

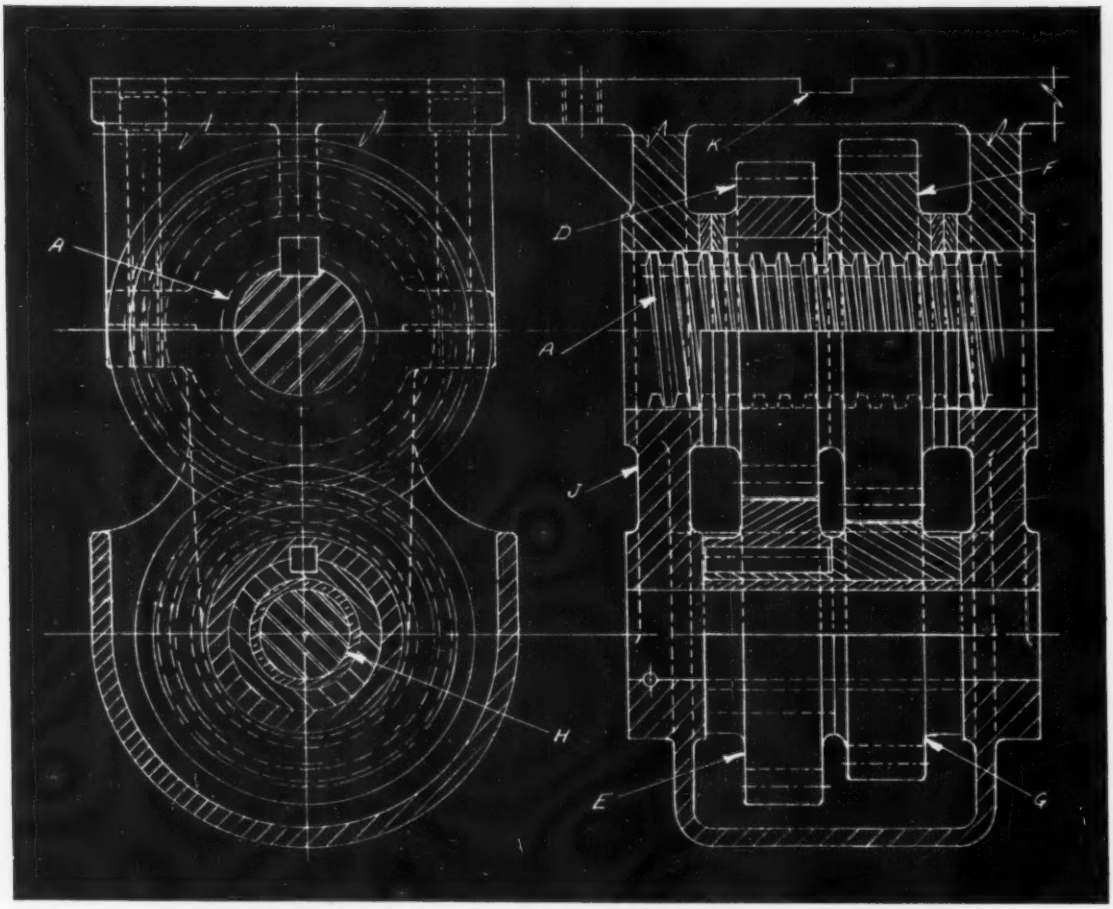


Fig. 2. Each of the boring-bar supports has a reduction gear train driving from the keyway in lead-screw (A). Gear (D) carries the key but only slides over the lead-screw. Gear (F) drives the nut forward via the reduction gear train from (G) to (E).

of housing *C*; support *Y* at one-half the speed of *C*; and support Z at three-quarters of that speed.

The boring-bar feed is by means of the lead-screw *A* which is driven by a gear train in housing *C*. A nut *B* carries housing *C* forward as the screw is rotated. The screw *A* is provided with a keyway its full length. The bearing at the left end of *A* is arranged to take axial thrust in both directions. Nut *B* is rigidly attached to housing *C*. Therefore, one revolution of shaft *A* will, of course, move housing *C* a distance equal to the pitch of the thread. If, however, this nut is rotated in the same direction and speed as the screw, there is no forward motion of housing *C*.

Fig. 2 shows in detail the mechanism used under each support that gives forward motion. The motion consists of a cluster of four gears. Gear *D* slides on lead-screw *A*, and is turned by a feather key fastened in the bore of gear *D*. Gear *E*, which meshes with *D* and is mounted on the hub of gear *G*, makes a compound idler mounted on shaft *H*. Gear *F* is threaded to fit lead-screw *A*. All four gears are held in a cage *J*, which is attached to the underside of its particular support, and held from axial-movement keyway *K*. By changing the ratios between gears *D*, *E*, *G*, and *F*, the supports can be caused to move toward *W* at the desired different speeds.

In the case of support *X*, the travel will be one-fourth of that of *C*. This speed is obtained by subtracting three-quarters of the distance a fixed nut (as *B*) would travel on the lead-screw. This is accomplished by driving gear *F* at three-quarters of the speed of screw *A* in the same direction. This gear-train ratio is $D/E \times G/F$, or, in terms of gear teeth, it is $35/35 \times 30/40 = 3/4$. Gearing for support *Y* is $30/60 \times 45/45 = 1/2$; and for support Z, $30/60 \times 30/60 = 1/4$.

To avoid errors of spacing in the assembly of this device, the supports and housing were assembled to the lead-screw at its far left. By turning the screw in reverse, the housing and supports assumed the proper position to carry the retracted boring-bar.

TOOL ENGINEERING *Ideas*

Tools and fixtures of unusual design and time- and labor-saving methods that have been found useful by men engaged in tool design and shop work

Phantom Center Permits Turning Big Tubes in Engine Lathe

H. J. GERBER, Stillwater, Okla.

A small universal chuck and an adapter, Fig. 1, combine to make a tailstock bearing that extends the applications of engine lathes. Screwed into the chuck back-plate, Fig. 2, the arrangement permits turning large tubes on an engine lathe, using the 60-degree center seat (Fig. 1) as a tailstock bearing. The headstock end of the tube is held and driven by a three-jaw chuck, as in Fig. 2, in typical fashion for turning the outside diameter of a cylinder.

Another application for the adapter is when a tubing work-piece is too long to be held between the regular centers. Used in this way the chuck and its adapter are supported by a standard steadyrest. The steadyrest is seated at the extreme end of the lathe bed, Fig. 3, with the tailstock removed. The shank surface of the adapter is ground concentric with the axis so that it makes a good bearing.

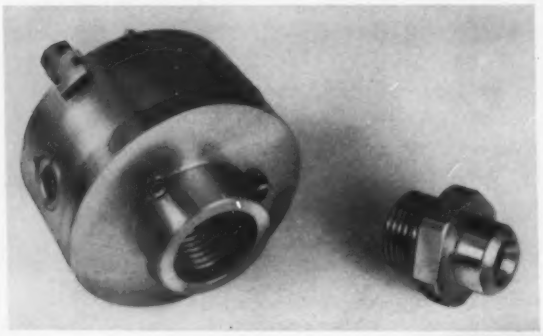


Fig. 1. (Above) Make-up of the phantom center is shown with the universal chuck on the left and the adapter with its mating thread on the right. The ground shank for steadyrest use and the 60-degree center seat show at the extreme right on the adapter.

Fig. 2. (Above) Phantom center in use, turning a length of tubing with the 60-degree center seat of the adapter supporting the work and tail chuck in conventional style.

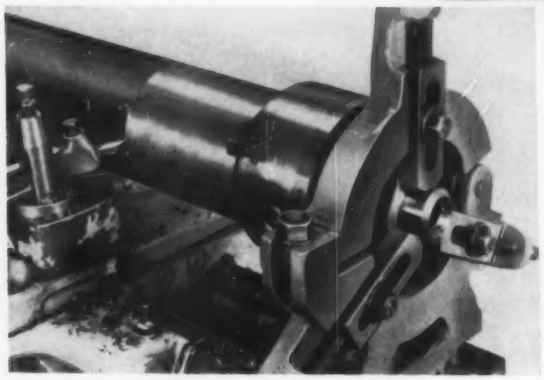
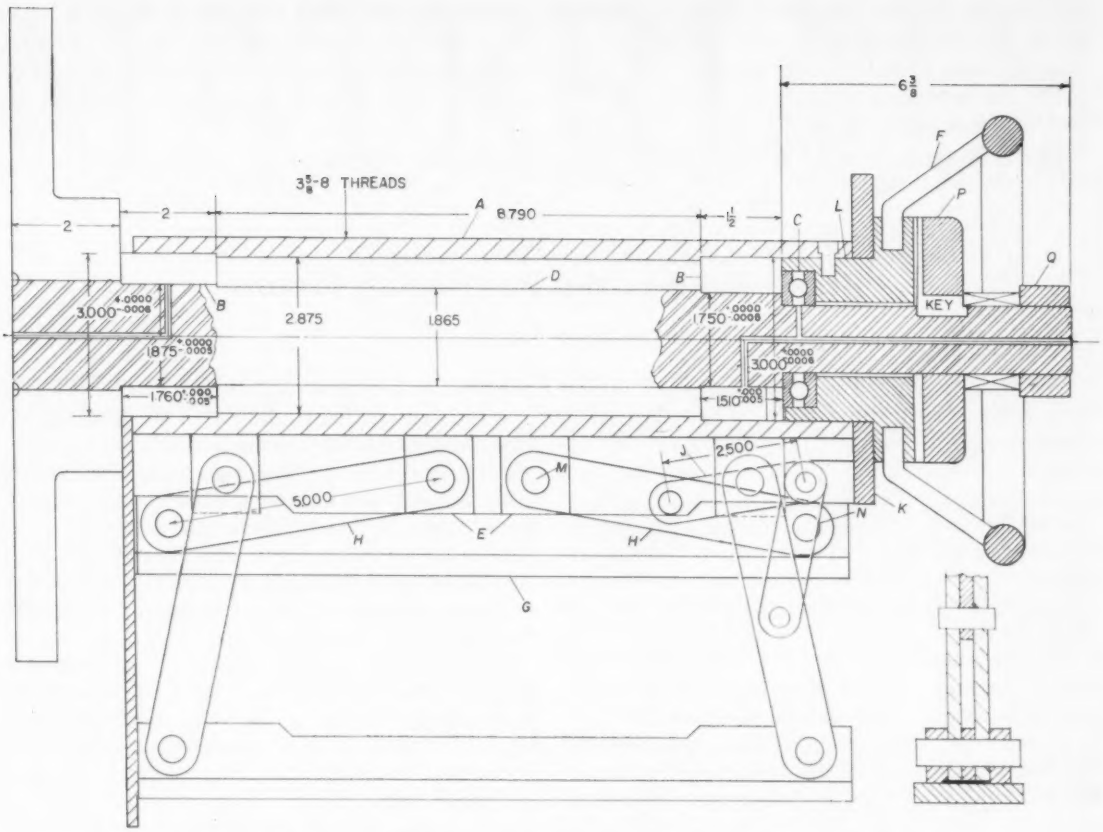


Fig. 3. (Left) Work-piece, too long for tailstock centering, is held for turning by the steadyrest mounted at the end of the lathe bed and bearing on the adapter shank.



The mandrel is adjusted by rotating cylinder (A), through handwheel (F), independently of shaft (D). This causes nuts (E) to move laterally, and thus, through toggles (H), causes the gripping arms (G) to move radially. Fully expanded position of arms is shown in color.

Expanding Mandrel for Coil Stock

EMIL LOEFFEL, New York City

A mandrel for coil-stock feeders features three radially adjustable arms which compensate for differences in coil hole sizes among the various suppliers. Because it has three arms instead of the customary four, the device can exert a more effective grip when a hole is out of round.

The mandrel handles coils weighing up to 1 ton, with hole diameters from 9 to 17 inches. It is automatically self-centering, and is tightened and loosened by turning a handwheel. In use, the coil is placed on the mandrel, which is adjusted beforehand to approximate size. Then the mandrel is tightened, expanding the arm diameter about 1/4 inch with each turn of the handwheel.

A drag brake prevents overriding and helps produce a smooth feeding action. The mandrel always rotates in a direction which tends, due to the drag, to tighten it against the coil.

Cylinder *A* is supported and held in place by two roller bearings *B* and thrust bearing *C*, and is free to rotate around shaft *D*. The entire external surface of the cylinder is threaded: One half is a right-hand thread, and the other half is a left-hand thread. Each half is engaged by a nut *E*. These nuts move toward or away from each other when, by means of handwheel *F*, the cylinder is caused to rotate independently of the stationary shaft.

Each of the three gripping arms *G* (only one is shown) is connected by two toggles *H* to the nuts. In addition, there is pinned to the center of one toggle of each arm a restraining link *J*. The other end of the link is pinned to a stud on ring *K*, which is confined axially by the end of the cylinder and plug *L* but is free to rotate during adjustment of the mandrel. Purpose of the link is to assure that the arm remain parallel with the cylinder and in the same vertical plane. It is, of

course, necessary that the link swing on the stud at the intersection of the lines describing the motion of points *M* and *N* of the toggle.

Drag is produced on the rotating members by the thrust of collar *P* against plug *L*. The collar is keyed to shaft *D*, and the amount of thrust it exerts on the plug can be adjusted by turning the spring-loaded nut *Q* in either direction.

To tighten or loosen the mandrel, the expanding linkage must be prevented from rotating with the handwheel. The weight of the coil is sufficient to prevent this movement. If the mandrel has to be adjusted before a coil is positioned on it, a restraining hand can be placed on one of the arms.

Brake Band Locks Positioning Fixture

ROGER ISETTS, Kenosha, Wis.

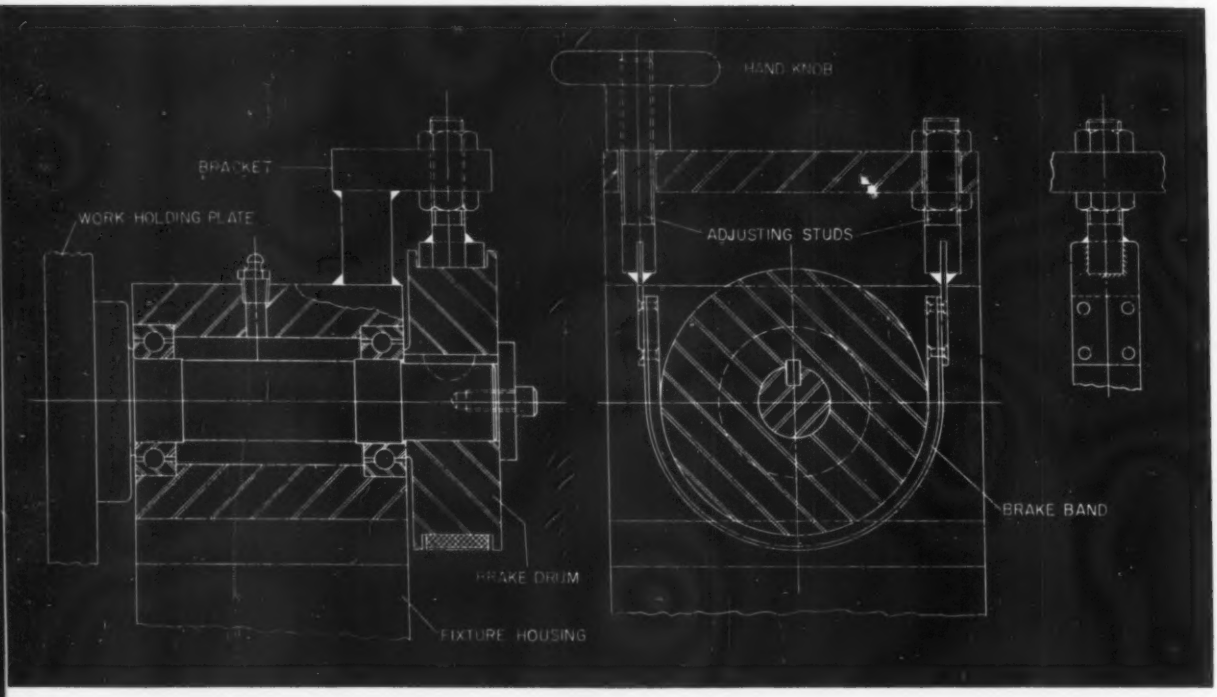
Welding, brazing, assembly, and other similar type fixtures very often have to be adjusted to numerous positions while performing various operations. Complicated plunger type indexing mechanisms are usually slow acting as well as unwieldly and difficult to operate. Illustrated, however, is a simple and inexpensive braking arrangement that facilitates positioning, thus reducing operator fatigue while helping to increase production.

To make use of this braking arrangement, the fixture housing is bored to receive ball, roller, or needle bearings. These can be of either the open or sealed type, depending on the application of the fixture. The end of the main shaft opposite the work-holding plate is turned and a keyway is milled to accept a single brake drum as shown.

A bracket welded to the top of the housing has two clearance holes drilled through it to accommodate brake-band adjusting studs. The bottom ends of the two studs are slotted and have mild-steel strips welded to them which are, in turn, riveted to the brake band. The brake band itself is of simple construction. It is made by riveting a length of standard brake lining to a backing sheet of either brass or steel.

Two jam nuts on the right-hand stud not only lock it to the bracket, but also permit adjustment of the brake band. In operation, slight tightening of the hand knob on the left-hand stud will clamp the work-holding plate securely in any position desired.

Locking of rotary fixture in any position is accomplished simply by the use of a brake drum and adjustable brake band. The brake drum is keyed to the shaft carrying the work-holding plate.



MATERIALS

The properties and new applications of materials used in the mechanical industries

Five Grades of Cemented Carbides that Are Now Available

Five grades of cemented carbides called New-Bide, with Rockwell A hardnesses ranging from 91.2 to 93.0 and with transverse rupture strengths from 225,000 to 325,000 psi, have been announced by Newcomer Products, Inc., Latrobe, Pa. The first, "N-20," is a fine-grain, high-tensile general-purpose grade for machining cast iron and nonferrous materials. It has good crater resistance for the alloy types of cast iron. Another, "N-50," is recommended for heavy cuts on steel and as a general-purpose grade. This grade exhibits good resistance to mechanical and thermal shock as well as to wear.

Another grade, "N-60," has been designed for general-purpose machining of steel under normal conditions. It has less shock resistance, but greater wear resistance than the N-50 grade. Another, "N-70," is a general-purpose finishing grade for moderate cuts at relatively high speeds; and the last, "N-80," is a high-speed finishing and precision boring grade offering good wear and thermal, crater, and shock resistance.

Circle 565 on Readers' Service Card

Columbium-Bearing, Low-Alloy Steels with High Strength

Two columbium-bearing, high-strength, low-alloy steels with yield points of 50,000 and 45,000 psi have been announced by Armco Steel Corporation, Middletown, Ohio. Armco High Strength No. 6 and No. 7, as they are called, are available as plates, hot-rolled sheets, and hot-rolled strip.

The corrosion resistance of these materials is equivalent to mild, noncopper-bearing steels. Formability characteristics include simple bending across the rolling direction, flanging, and light forming operations of the type regularly performed on standard commercial quality steel and plate. The No. 6 steel exhibits welding properties similar to a 0.20 per cent carbon steel, while the No. 7 steel has properties similar to a 0.10 per cent carbon steel.

Hot-rolled products of both steels can be supplied in the pickled condition in maximum lengths of 200 inches for sheets up to 60 inches wide and 180 inches for wider sheets.

Circle 566 on Readers' Service Card

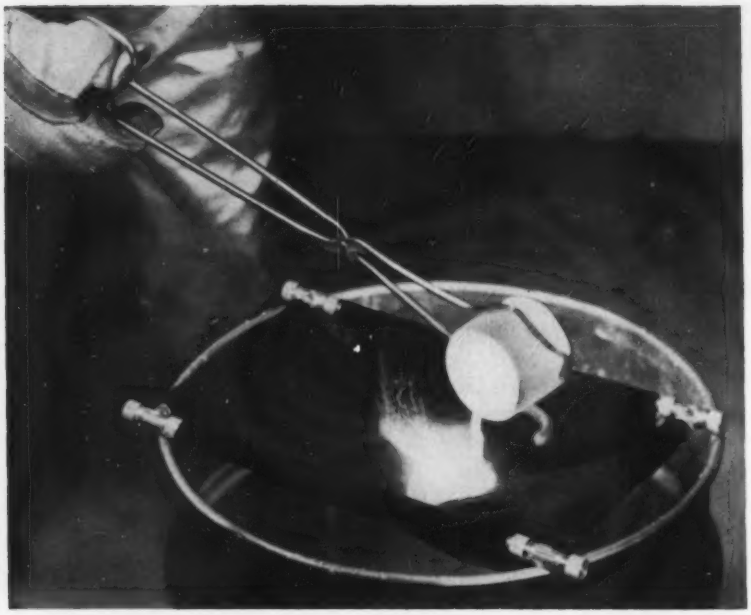
Composite Tubing Combines Corrosion Resistance with Weldability

A composite tubing which has an inside lining of stainless steel and an outside casing of carbon steel is being produced by the Allegheny Ludlum Steel Corporation, Pittsburgh, Pa. Tests show that a complete and inseparable high-strength metallurgical bond is formed between the two types of steel.

One use that the tubing is put to in nuclear reactors is to carry the cooling medium for the fuel system. The stainless steel provides the necessary corrosion resistance on the inside of the tubing, and the carbon steel on the outside facilitates making a strong weld of the tubing to the reactor structure.

Circle 567 on Readers' Service Card

A strong inseparable metallurgical bond exists between the inner lining of stainless steel and the outer casing of carbon steel of this composite tubing.



One pound of molten steel heated to 3000 degrees F. is shown being poured onto a 1-pound-per-square-yard fabric of Pluton heat-resistant fiber. The steel solidified on the fabric without burning through it.

All-Organic Fiber that Withstands Exposure to Intense Heat

An all-organic, heat-resistant fiber which retains its flexibility and part of its strength after exposure to intense heat has been announced by Minnesota Mining & Mfg. Co., St. Paul, Minn. Called Pluton heat-resistant fiber, this product is available as a fabric or it may be worked into laminates reinforced with high-temperature phenolic resin to form structural parts or molding compounds. The fiber is entirely free of elemental carbon and conducts very little heat or electricity. It does not char or melt.

Potential uses for the fabric are missile motor case liners, insulation for drag-chute compartments in high-speed jet aircraft, antiarc wraps in electrical power plants, lightweight fire-protective curtains in public buildings, mines, steel mills, and other places that require them.

Circle 568 on Readers' Service Card

Process Which Gives Carbon Steel Properties of Stainless Steel

A new diffusion process which increases the resistance of carbon steel to heat, corrosion, and wear has been announced by Alloy Surfaces Co., Wilmington, Del. The process, called Alphatizing, supplies an adequate and controlled amount of chromium to the surface of the carbon steel in the form of a true alloy. Mild or low-carbon steels show greatest chromium penetration. The higher the carbon content of the base metal, the less will be the penetration, but the greater will be the case hardness.

A modified process has been developed for ordinary air-hardening tool steels that do not require drastic quenching in order to effect core hardening. This process not only provides carbide surfaces but also brings about simultaneous core hardening of the base metal as well. Tooling thus treated is bright in appearance and will resist galling and fretting corrosion.

Applications include jet-engine vanes, truck mufflers, strip heater casings, communication relay parts, and can-seamer rolls.

Circle 569 on Readers' Service Card

Mildly Acidic Burnishing Compound for Zinc, Aluminum, and Steel

A burnishing compound for zinc, aluminum, steel, and other metals has been announced by Oakite Products, Inc., New York City. The compound, called Oakite FM 286, works well on all metals except magnesium. It is mildly acidic and produces a brilliant blue-white color on zinc die castings. It often eliminates the need for the bright-dip operation on metals which develop oxide films. As the compound contains no soap, it will not leave a film to hinder plating. It has a good hard-water tolerance.

Circle 570 on Readers' Service Card

Zinc Die-Casting Alloy for Complex Castings with Thin Wall Sections

A zinc-die-casting alloy, designated Zamak-7, which facilitates production of zinc die castings with good surface finish and thin wall sections has been announced by the New Jersey Zinc Co.,

New York City. Its lower casting temperature means long die life with a minimum of maintenance and little fouling of dies.

Circle 571 on Readers' Service Card

Creep-Resistant Titanium Alloy for Elevated Temperature Use

A creep-resistant titanium alloy which contains 8 per cent aluminum and 1 per cent each of molybdenum and vanadium, in addition to 90 per cent titanium, has been placed on the market by Titanium Metals Corporation of America, New York City. Designated Ti-8A1-1Mo-1V, the alloy has a density of 0.156 pound per cubic inch. Dies and forging practices used for forging other titanium alloys can be used in the production of parts manufactured from this alloy.

Employment of the alloy extends titanium's usable strength in aircraft jet engines to 900 degrees F. Parts made from it include compressor discs, spacers, and blades.

Circle 572 on Readers' Service Card

Aluminum-Coated Steel Wire with Strength, Conductivity, and Corrosion Resistance

An aluminum-coated steel wire which exhibits good strength, electrical conductivity, and corrosion resistance has been developed by the National-Standard Co., Niles, Mich. Alstan, as it is called, has been produced with an aluminum coating of 20 to 60 per cent of the total cross-sectional area. This gives an electrical conductivity of 20 to 40 per cent of equivalent sizes of copper wire. It is expected that power transmission lines could offer a broad market for the wire.

Circle 573 on Readers' Service Card

Highly Conductive Solder Type Alloy Now Available

A solder type alloy designed especially for electrical and electronic work has been announced by Eutectic Welding Alloys Corporation, Flushing, N. Y. Called Neu-Tec-Tronic 157BN, the alloy is 50 per cent more electrically conductive than the standard 50-50 lead-tin solder. The flux core is inert after carbonization, and residues are noncorrosive and nonconductive and do not support fungus growth. Other advantages attributed to this alloy are a low melting point and a high solidification rate.

The alloy can be applied with a soldering iron, torch, by hot plate, or induction heating.

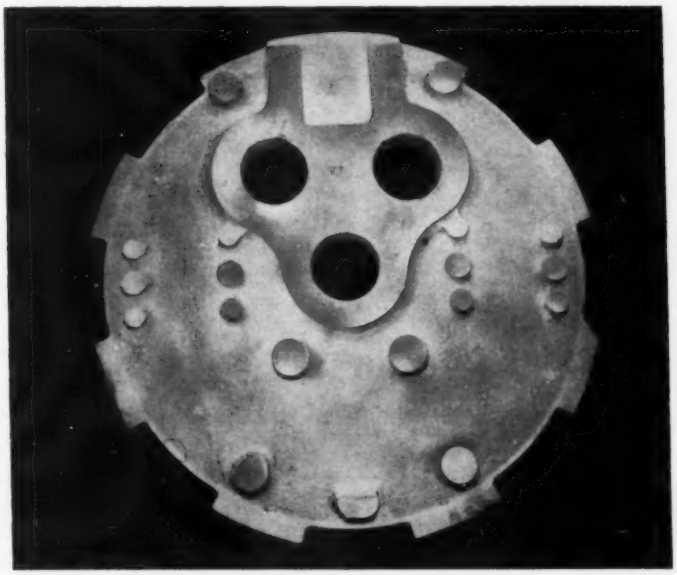
Circle 574 on Readers' Service Card

Tough Die Steel with Good Shock and Abrasion Resistance

A chromium-molybdenum-vanadium alloy die steel furnished in the prehardened condition, ready for sinking, without further heat-treatment by the user has been made available by Heppenstall Co., 4620 Hatfield St., Pittsburgh 1, Pa. The steel, called Hardtem, possesses good toughness and shock-resistant qualities and is resistant to abrasion, heat checking and cracking, and the effects of elevated temperatures. Its ability to retain strength and shape, along with its resistance to disintegration of the die impressions, is paramount for use at present-day drop-forging temperatures and production.

This grade is also a good choice for use as machinery parts and extrusion component parts such as bushings, rollers, shafts, and gears.

Circle 575 on Readers' Service Card



This is a 26-inch torpedo-tube breech door weighing 250 pounds and cast of recently developed ACI (Alloy Casting Institute) Type CD-4MCu precipitation-hardenable stainless alloy. Typical mechanical properties of the alloy casting are a 110,000-psi tensile strength and an 85,000-psi yield strength. This breech-door casting will be used on the latest type of nuclear submarine, SS(N) Thresher.

Circle 576 on Readers' Service Card

NOMOGRAM SHOWS INCREASE IN EDGE THICKNESS IN DRAWING

RUDOLPH GRUENBERG
Lamp Division
Westinghouse Electric Corporation
Bloomfield, N. J.

THE INCREASE in metal thickness at the blank edge, which occurs in drawing, is an important value because it affects the tool design and the spring of the drawn part. Presented here is a nomogram by which this increase can be predetermined.

In drawing sheet metal, it is forced to stretch considerably in one direction while being compressed in the other. The simplest example is the drawing of a cup, yet all deep-drawing operations, however complex, involve the same phenomenon.

As can be observed in Fig. 1, sector AOB of the blank has shrunk as it moved toward the die opening, while it has stretched passing over the drawn radius. It is wedge-shaped in the bottom and the flange, but becomes rectangular in the wall of the cup. Varying stress and strain conditions to which the blank is subjected account for the different types of failures in drawing.

Theorize that sector AOB is cut out of the blank and forced frictionless and without the use of a blank-holder into the die cavity. The sector is subjected in a radial direction to tension, and tangentially to compression. The radial forces decrease toward the periphery and become zero at the edge of the blank, so that the edge is subject to compression only. Accordingly, the flange must either thicken or wrinkle.

As shown in Fig. 2, an outer fiber of width W_1, thickness T_1 and radius r_1 will move toward the center and assume a new width W_2, thickness T_2, and radius r_2.

Assuming that the volume remains constant, then

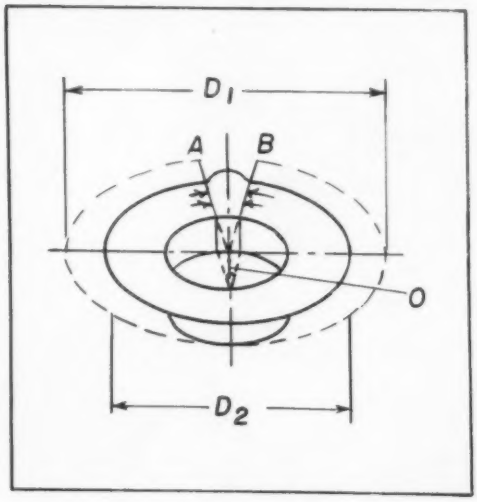
$$r_1\alpha\ W_1\ T_1 = r_2\alpha\ W_2\ T_2, \text{ or}$$

$$\frac{r_1}{r_2} = \frac{W_2\ T_2}{W_1\ T_1} \quad (1)$$

The cross sections of a body when compressed by various amounts remain geometrically similar. Thus,

$$\frac{W_2}{W_1} = \frac{T_2}{T_1} \quad (2)$$

Fig. 1. Sector AOB is wedge-shaped in the bottom and in the flange of drawn cup, but rectangular in the wall area.



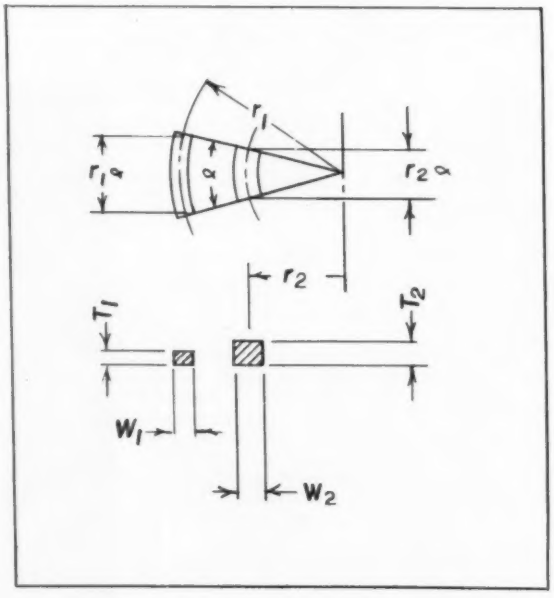


Fig. 2. As the outer fiber is drawn toward the center, its thickness increases from (T_1) to (T_2).

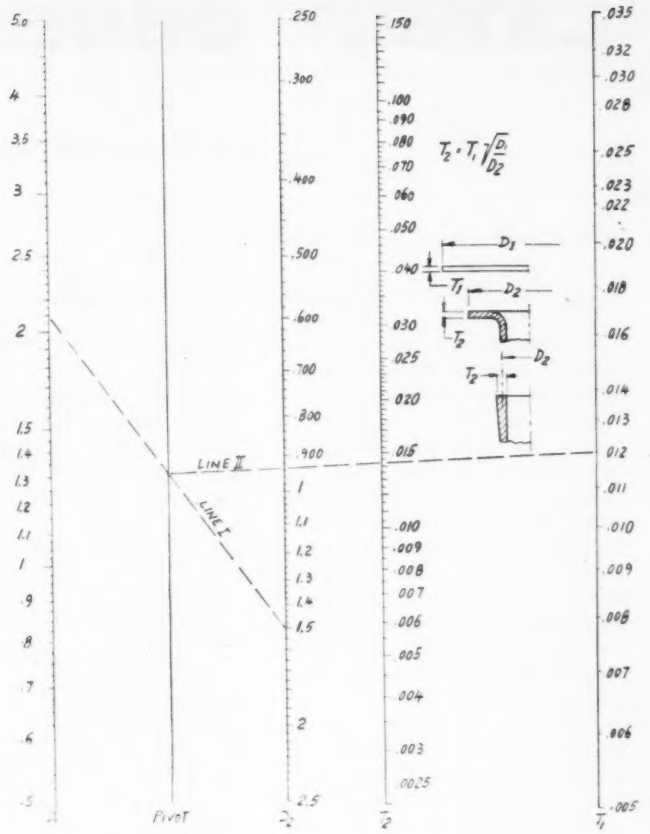
This value introduced into (l) gives:

$$(3) \qquad \frac{r_1}{r_2} = \frac{T_2^2}{T_1^2}, \text{ or } T_2 = T_1\sqrt{\frac{D_1}{D_2}}$$

This is the equation on which is based the following nomogram. The values as taken from it depend primarily on the reduction in diameter from the blank to the cup; and if the part has a flange, also on the reduction in diameter from the blank to the flange edge.

Appearing on the nomogram is a typical illustration of its use—in this instance, to find the increased thickness of the drawn flange (or flangeless wall) T_2. Blank diameter D_1 is 2.10 inches; blank thickness T_1, 0.012 inch; and drawn diameter D_2, 1.50 inches. This procedure is followed:

1. On the D_1 scale, point off 2.10.
2. On the D_2 scale, point off 1.50.
3. Connect points on D_1 and D_2 scales with Line I.
4. Connect intersection of Line I and pivot scale with Line II to 0.012 on T_1 scale.
5. Read increased flange thickness, 0.0143 inch, at intersection of Line II with T_2 scale.



Enter the Metal Powder Annual Awards Contest

The powder metal industry's only annual award competition is now under way, sponsored by the New Jersey Zinc Co. Open to all fabricators and users of brass, nickel-silver, and prealloyed bronze powder, there is a $500 cash award for both the parts fabricator and the product manufacturer who submits the part that best satisfies the objectives of the contest. The competition is already in progress, with the closing date for entries February 28, 1961.

"Originality of application, uniqueness of design, production economy achievements, and the best utilization of metal powder properties and fabricating techniques" are the criteria which independent judges will use to select the Grand Prize winner. One $500 award will go to the individual chosen by the product manufacturer as the man most closely associated with the conception and design of the brass, nickel-silver, or prealloyed bronze part selected as the Nonferrous Metal Powder Part of the Year. Another $500 cash award will go to the man deemed by the fabricator as most responsible for the successful production of the Grand Prize winner.

The number of entries from each contestant is unlimited. Any product, assembly, or component of a new design or a redesign which uses a structural or mechanical part made of brass, nickel-silver, or prealloyed bronze powder is eligible, providing the part was made after January 1, 1960, or will be in production by February 28, 1961. Entry blanks are available from the Awards Editor, Metal Powder Press, the New Jersey Zinc Co., 160 Front St., New York 38, N. Y.

LATEST DEVELOPMENTS

Machine tools, unit mechanisms, machine parts, and

Monarch Kompact Lathe in Low-Cost Range

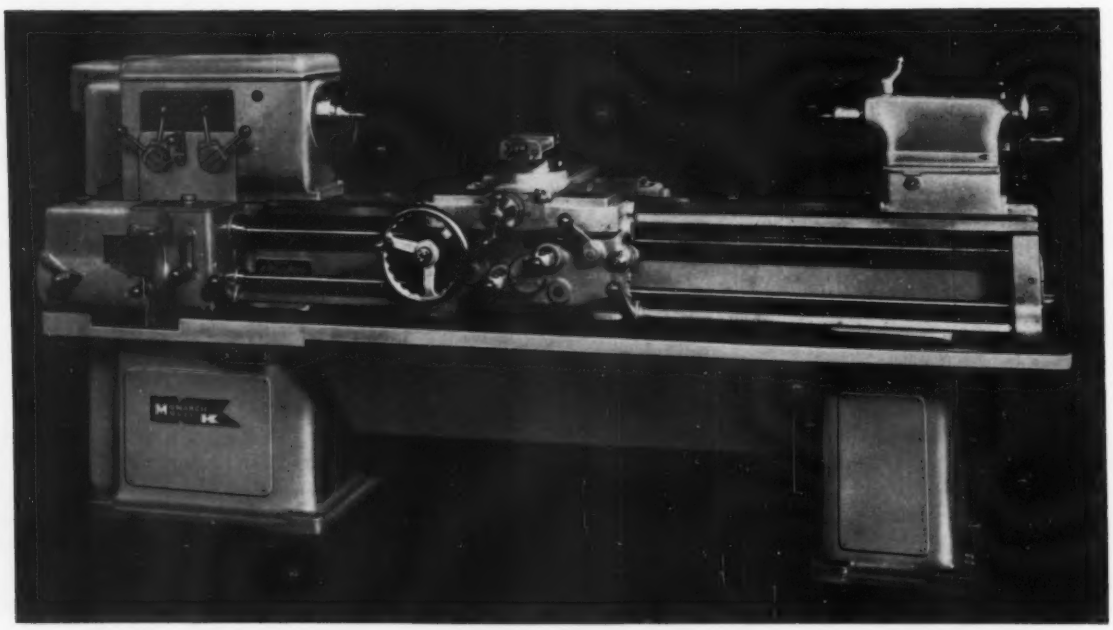
A Model K Kompact lathe developed to sell in the low-cost range has been brought out by the Monarch Machine Tool Co., Sidney, Ohio. This new machine has field-proved production and accuracy features, and is designed to handle all conventional turning, boring, facing, and thread-chasing work. Swing over the bed is 16 inches; swing over the cross-slide, 10 inches; and center distance, 54 inches. The bed is a heavily ribbed, superalloy casting with four flame-hardened and precision-ground ways. There are sixteen geared speeds in a range of 28 to 1200 rpm. The sturdy headstock features heat-treated and accurately finished helical gears designed for smooth, quiet transmission of power.

Precision type, tapered roller bearings support the spindle, which has a 6-inch Type D-1 hardened Camlock nose. Headstock lubrication is automatic. The 5-hp main-drive motor is mounted inside the cabinet leg. Drive to the spindle is through balanced, multiple V-belts. All U. S. standard and U. S. fine threads are included in the forty-eight-thread range. Feeds per revolution range from 0.0012 to 0.070 inch. The end gear train is arranged to accept compound gearing for chasing odd-lead threads.

Both longitudinal feed and cross-feed are through large, cone type friction clutches. The apron worm drive to the hardened rack pinion assures smooth, uniform carriage feed. A precision leadscrew, used only for threading, is mounted in antifriction thrust bearings. An automatic lubrication system supplies metered oil to apron parts, carriage bearings on bed, and compound-rest bottom slide bearing on the carriage.

The carriage way surfaces are hand scraped to fit the bedways. All slides are extra-heavy for sturdy tool support. Precision cross-feed and compound screws are used. The large, direct-reading dials are graduated in thousandths of an inch. Compound rest and tailstock are designed with clearance for use of compound parallel to spindle center.

The hardened and ground, dead-center tailstock spindle is provided with a drift slot for tool ejection. The tailstock is arranged for quick clamping to the bed and has a centralized lubrication system. A graduated scale on the



Model K low-cost Kompact lathe introduced by Monarch Machine Tool Co.

IN SHOP EQUIPMENT

material-handling appliances recently introduced

Edited by FREEMAN C. DUSTON

spindle facilitates drilling operations. Commonly used items of accessory equipment are available from stock. These include taper attachment, rests, stops, and many others. The Model K may also be used for tracer turning upon application of the Monarch Air-Tracer Pak.

Circle 580 on Readers' Service Card

DeVlieg Announces Hole-Boring Machine Equipped for Quick, Precision Locating

The precision-locating feature of a special machine designed and built by the Microbore Division of DeVlieg Machine Co., Royal Oak, Mich., is said to be to automated boring operations what the "Transite" system of pin-pointing "locations" on the high seas is expected to be to navigation. Both of these locating systems eliminate the use of numerous mathematical calculations, extensive application of instruments and gages, and time-consuming checking work. But, where triangulation is used by the space navigational system to find a vessel's location within one-tenth of a mile, a single "fix" of the locating equipment of the hole-boring machine from a gage line serves to automatically hold all subsequent positioning dimensions closer than 0.001 inch. The new machine is now being used by the Microbore Division of the DeVlieg Machine Co. to supply extremely accurate preset tooled boring-bars for automated mass production in the automotive and agricultural industries.

The hole machine, as it is called, will handle bars of all types, including straight, NMTB tapered, stub, flanged, and many types of turret lathe bars. It will also accurately locate and machine the proper holes for boring tool cartridges to accommodate any combination of single or multiple precision tooling work.

Special DeVlieg hole-boring machine with operator who has just selected tooling for machining a boring-bar

Three machines like the one illustrated are being used to produce about 350 different standard precision boring-bars, as well as bars for special purposes. These bars are said to be so accurate that the tooling for use in mass automatic machining operations can be preset in groups of several hundred bars with full assurance that at least they will require only minimum adjustment on the job.

The key elements of the special hole machine are a kidney-shaped, two-axis rotary positioning plate and a standard precision spindle head. The latter is of the same type used on a standard Jigmil, complete with turret control, tool-lock features and wide range of feeds and speeds. The positioning plate has about twenty holes on its kidney-shaped outside edge. When the positioning plate swivels about the dead center line of the spindle bar, these holes will spot any combination of angles needed for machining the required holes in a boring-bar.

A special weldment, which includes a platen having the in-and-out movement features associated with the company's standard machine tools, forms the base of the machine. It holds the spindle head, as well as the pivoting kidney-shaped positioning plate fixturing. The work is held in special fixtures attached to vertical and horizontal moving slides—all supported by the rotating positioning plate.

Both Vernac and micrometer-rod measuring systems are employed in connection with the horizontal travel of the special

work-holding blocks. Both can be employed to assure extremely close tolerances in establishing point-to-point accuracy in picking off the hole dimensions. A "Lazy Susan" type stand designed to service each hole machine is divided into "pie" sections or segments, each holding all the tooling related to the size holes the operator is machining in a given boring-bar. Some of the tools in one of these holders may be seen in the lower left-hand corner of the illustration.

Circle 581 on Readers' Service Card

Long-Stroke Vertical Boring Machine with Tilting Fixture

The Foote-Burt Co., Cleveland, Ohio, has announced a vertical, three-spindle, high-precision line-boring machine with a 48-inch stroke and hydraulic feed. The first of these new machines is being used to finish-bore camshaft-bearing holes, the balance hole, and crankshaft-bearing seats in V-6 and V-12 engine blocks. It is arranged vertically to save space and occupies only a fraction of the floor area required for a horizontal machine.

The hydraulic feed locates the engine block in the fixture, which is up-ended to align the work holes with the boring tools. Before starting rotation, boring-bars approach the work in rapid traverse until the pilot enters the bore. The approach feed then stops, spindle rotation begins, and the boring-bars feed to full depth. After boring to depth, the tools retract and the indexing fixture revolves, discharging the block. Production is at the rate of fifteen blocks an hour at 80 per cent efficiency.

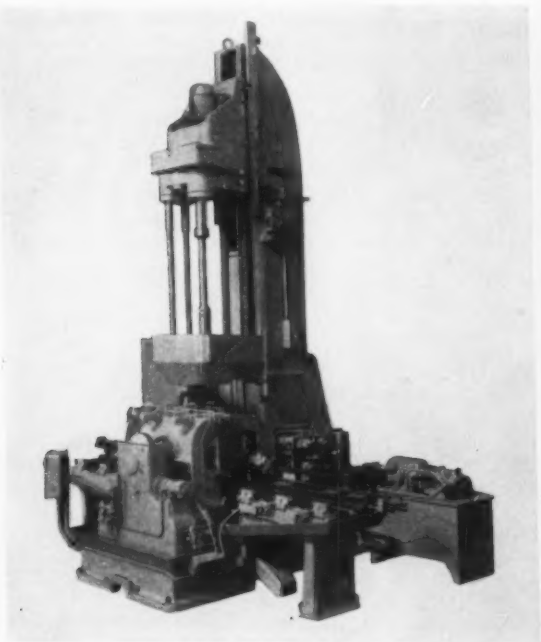
Tools enter the bores before they begin to rotate, since the long slender shafts would whip if not restrained. A time-delay switch allows the spindles to reach full speed before feeding. The machine has a massive cast-iron base and column for utmost rigidity. The head rides on vertical, square ways that assure 0.0005-inch accuracy over the entire 4-foot travel. Counterweights assure positive feed and retraction of the head at all times. The head cannot drop accidentally in case of hydraulic failure.

Circle 582 on Readers' Service Card

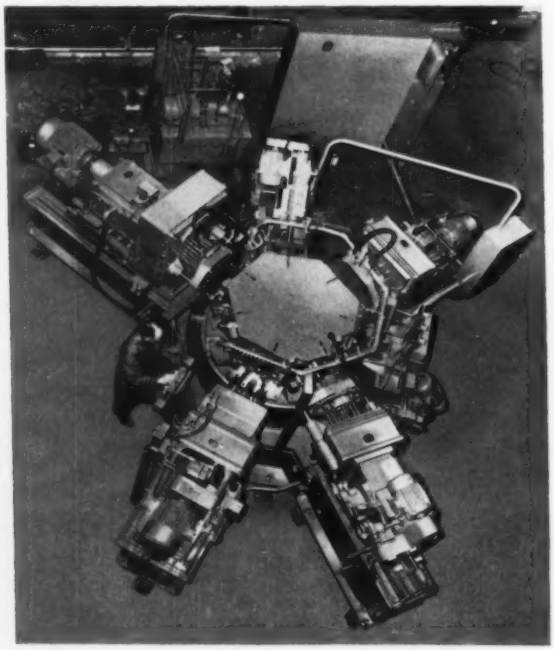
Machine for Processing Two Different Flywheels Saves Time and Space

A rotary type machine which performs all the drilling, reaming, counterboring, and tapping operations on two different flywheels has been designed and built by the National Automatic Tool Co., Inc., Richmond, Ind., for a major automobile manufacturer. The core of this machine is a seven-position rotary table surrounded by a group of six machining units and one loading and unloading station.

Each flywheel is fastened vertically against the table side by a precision collet which expands through the center hole in the flywheel. As the table indexes, multiple-spindle and single-spindle drill units advance and drill forty holes, ream fourteen holes, and counterbore and tap six holes.



Unloading and loading position of Foote-Burt boring machine equipped with tilting fixture



Rotary type machine built by the National Automatic Tool Co., Inc., for processing flywheels

Push-button controls enable the operator to select the operations necessary to machine either of the two flywheels. Chip removal is automatic—a brush moves with the turntable, sweeping chips before it into an underfloor conveyor.

Circle 583 on Readers' Service Card

Humidifier That Keeps Abrasive Belts from Curling

A low-cost humidifier that prevents edge cupping or curling of coated abrasive belts in dry atmospheres has been developed by the Behr-Manning Co., Troy, N. Y., a division of the Norton Co. This device is intended for easy in-plant fabrication by belt users. Advantages include increased belt life, higher permissible grinding pressures and, of course, improved grinding and finishing performance. As with most coated cloth or paper materials of similar dimensions, abrasive belts tend to curl at the edges if operated in low humidity that may prevail in winter. To remedy this condition, a slotted copper tube of 1 1/4-inch inner diameter and as long as the belt is wide is mounted close to the back of the belt, bathing the belt edges lightly with dry steam from the plant supply or a portable generator.

The two slots in the tube are 1/8 inch wide and 4 inches long; for 50-inch belts, slots may be 8 inches long. Centered within this tube is a 3/8-inch copper tube of the same length, with a line of 1/16-inch holes on 1/2-inch centers. This smaller tube should be oriented so that the small holes are 180 degrees from the slots in the outer tube. Steam is admitted to the small tube by a 3/8-inch fitting at one end, and a drain is rigged from a 1 1/4- by 1 1/4- by 1/2-inch tee and installed at the same end of the outer tube.

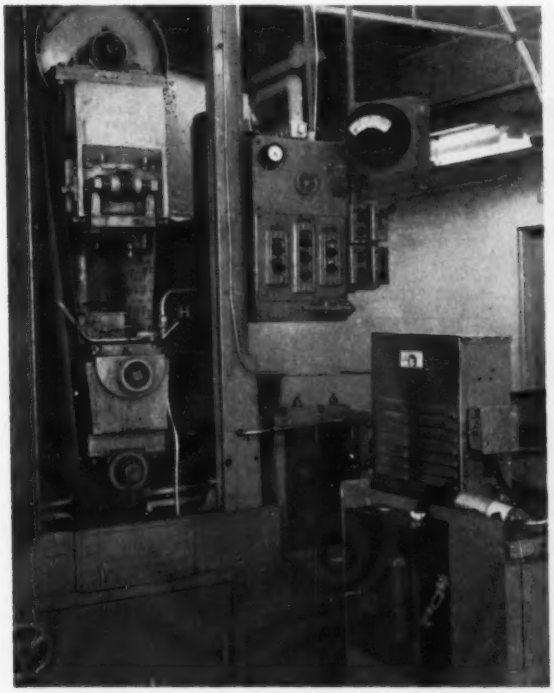
This simple device will deliver relatively dry steam from the slots, but condensate water will not reach the belt; instead, it will collect in the bottom of the larger tube and flow out via the drain. Steady application of a small quantity of steam will flatten a severely curled belt in less than a minute of operation, and will keep it flat. A control valve permits adjusting the device to furnish the minimum quantity of steam that will hold belt flatness. Normally, the steam will not even be visible, nor will it damage the belt or wet the work. Blueprints of the humidifier are available without charge from the Behr-Manning Product Engineering Department.

Circle 584 on Readers' Service Card

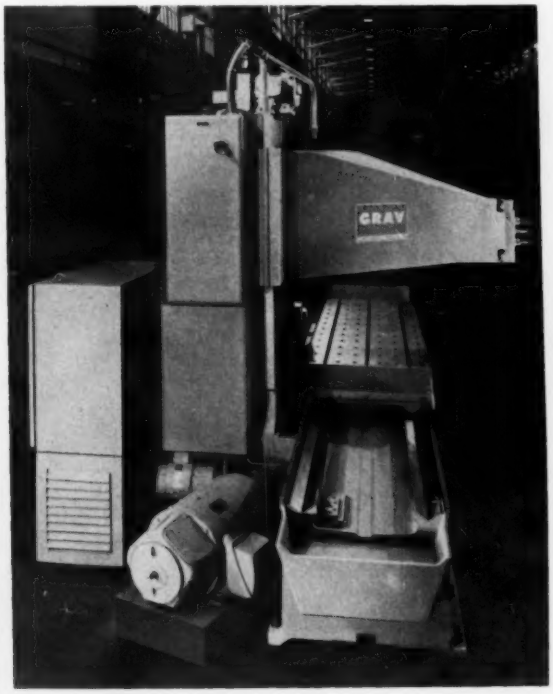
Gray Planer Equipped with Constant-Torque Drive

The new Flying Scot planer, made by the G. A. Gray Co., Cincinnati, Ohio, has a driving motor that provides constant torque over its entire range, giving ideal speed-torque characteristics. The unusual overload capacity of the drive permits the operator, on demand, to plow through heavy sections without slowdown or reduction in feed.

This new 60/75-hp variable-voltage drive has been developed expressly for the Flying Scot.



Humidifying unit (H) and portable electric steam-generating unit of Behr-Manning installation designed to prevent edge curling of abrasive belt



Rear view of new Gray Flying Scot planer showing drive-motor housing located in angular position, adjacent to bed on left, away from dust and chips

Speed adjustment in both the cut and return directions is independently adjustable from 180 to 1800 rpm. All adjustments are made by setting the rheostats which are located conveniently near the operator.

The standard planer ratio furnished is 6 to 1, providing table speeds of 30 to 300 fpm. This broad range of possible speeds permits the use of cemented-carbide tools at their most efficient speeds, or the planing of tough alloy steels at the low speeds required for maximum tool life. Alternate ranges offering different speed ranges are also available.

The drive is provided with a new adjustable control feature which automatically shuts down the rotating equipment when the planer is not cutting metal. Restart is conveniently controlled from the pendant station.

Circle 585 on Readers' Service Card

Dual-Frequency Heat-Treating Equipment

The Induction Heating Corporation, Brooklyn, N. Y., has designed and built for the Bennett Heat Treating Co., Inc., Newark, N. J., a 50-kw dual-frequency heat-treating machine. This is believed to be the only equipment of its kind ever built. It will be used to handle any heat-treating job on parts ranging in size from a needle point to massive gears. Both high and low frequency ranges are available, which are interchangeable, from 200 to 450 kilocycles and 5 to 10 megacycles. The machine permits selection of the precise frequency range best suited to the wide range of work encountered in modern job-shop heat-treating plants. Thus all work can be heated faster, with much less penetration and deformation.

Application of the new heat-treating machine to thin cross sections is said to have given amazing results. The high megacycle frequency range employed for heating items where thin cross sections were encountered, or where minimum skin-heating effects were desirable, also gave remarkable results. Among the items processed were high-precision (0.0001-inch tolerances) small and medium-sized gears. Because of the tendency for induced current of megacycle frequency to race on the surface, it was thought that a thin case hardness could be imparted to the fine teeth without damage. Examination showed that the hardness pattern did follow the contour of the gear teeth from face to root, and appeared similar to that produced by conventional case-hardening methods. Unlike the conventional methods, however, only the surface was heated by this frequency; therefore, practically no change in the gear dimensions occurred.

First dual-frequency 50-kw-powdered heat-treating unit ever used now in operation at plant of Bennett Heat Treating Co., Inc. Designed and built by Induction Heating Corporation for hardening, brazing, and annealing

Heating cycles were shorter than anticipated, making it necessary to employ a heat timer with 1/100-second sensitivity. In the case of extremely fine-tooth gears, the hardening temperature was reached in only one-fifth of a second. Uniformity in heating assured uniform hardness; and the split-second timing assured uniform work.

It was found that precisely the same equipment could harden, braze, or anneal high-precision parts, as well as standard-sized parts like gears, cams, shafts, or any other items that might require similarly selective hardening operations.

Most of the "regular" induction-hardening jobs could be processed with a frequency of about 300 kc at a substantially increased output because of the faster heating with less penetration. When deeper heating was desirable, output of the equipment was reduced and the heating time itself was extended by a few seconds. In many instances, it was found that quenching was unnecessary. For example, the rapid heating of the gears (mentioned above) brought them so swiftly to full hardness that no oil or water quench was used. Only the surface had been heated and the remaining unheated metal caused the parts to chill so rapidly that they became self-quenching. Nevertheless, the work stations of the machine are equipped for automatic spray or drop quenching of the work by water, oil emulsion, or oil.

Circle 586 on Readers' Service Card

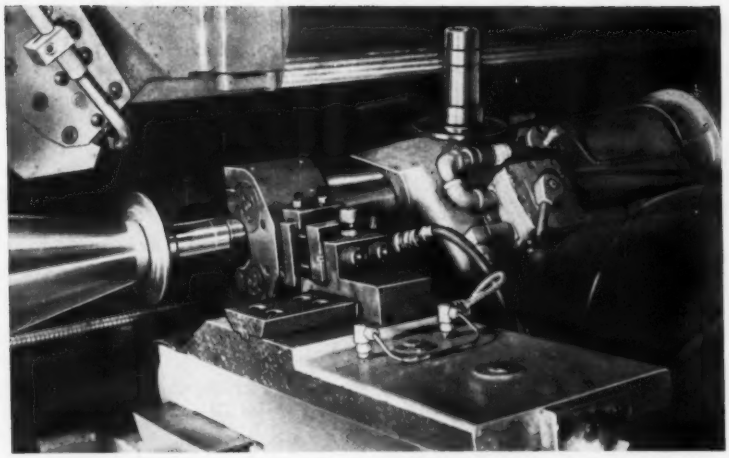


Fig. 1. Seneca Falls Model LQ automatic tracer lathe equipped for simultaneous turning and threading of front-wheel spindles

Seneca Falls Automatic Tracer Lathe Equipped for Simultaneous Turning and Thread Rolling

The Seneca Falls Machine Co., Seneca Falls, N. Y., has equipped its Model "LQ" automatic tracer lathe, Fig. 1, with an auxiliary front slide and thread-rolling attachment for forming threads on front-wheel spindles. The method of holding and driving the work-piece on centers, as well as the two tracer carriages and the front squaring attachment which supports the Reed threal-rolling attachment, is shown in the tooling layout, Fig. 2.

In operation, the left-hand overhead tracer-slide and the rear tracer-slide operate simultaneously; the overhead carriage feeding toward the tailstock and the rear carriage feeding toward the headstock. The rear tracer-slide is fitted with an indexing tool-block which presents a sharp cutting tool for a qualifying cut over the threaded end on a short-length second pass. Immediately following the second pass, the thread rolls advance to the center line of the work and then retract in rapid traverse.

The feed drive for the thread-rolling operation is through a variable-speed unit which controls the rate of feed as well as rapid-traverse movements. Cycle starting is initiated automatically by an electric signal upon completion of the second pass over the threaded diameter. The cross-slide of the front squaring attachment is operated by a barrel type cam that revolves through 360 degrees. The attachment may be adjusted along the bed to suit the location of the thread on the work-piece. The finish obtained by the burnishing action of the rolls is of a very high quality.

Circle 587 on Readers' Service Card

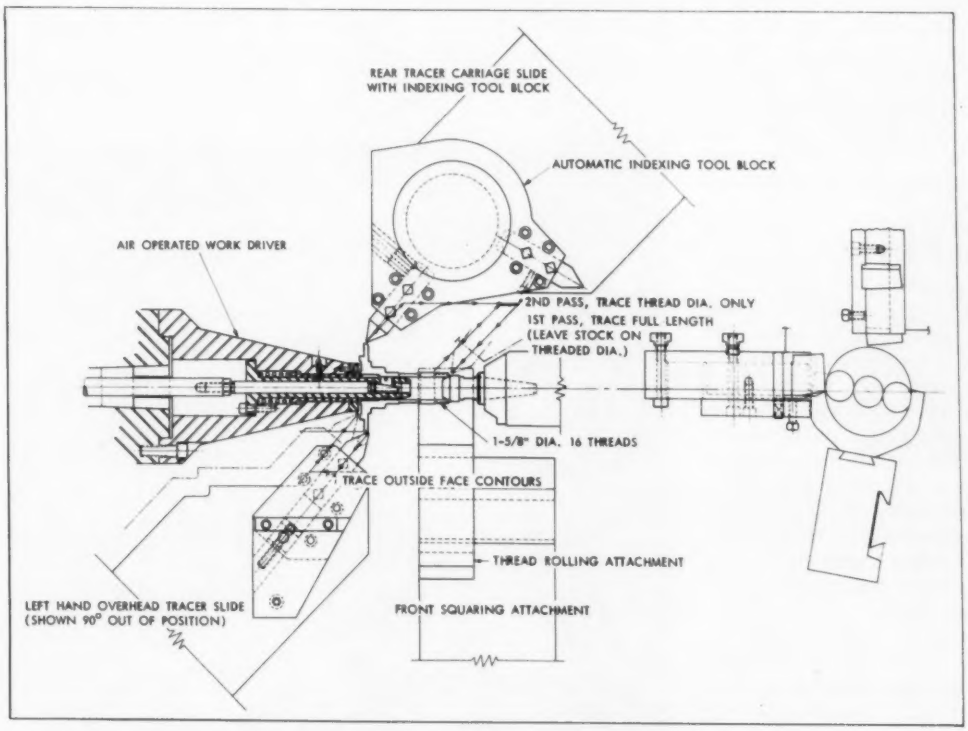
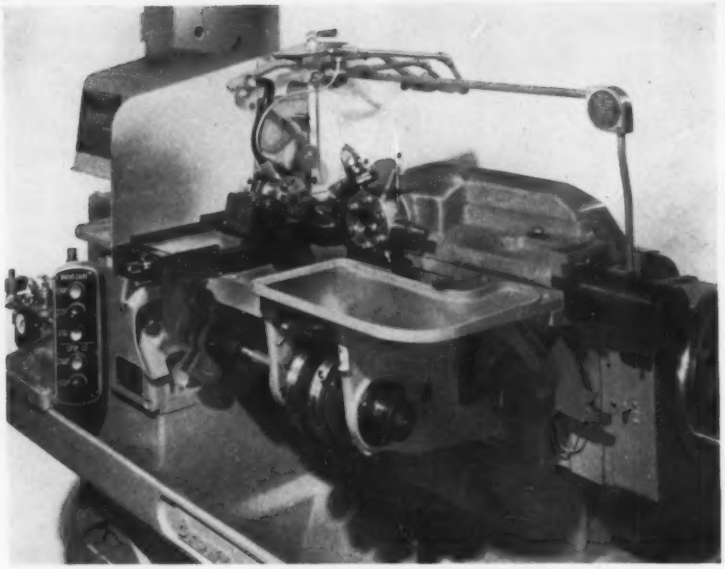

REAR TRACER CARRIAGE SLIDE WITH INDEXING TOOL BLOCK
AUTOMATIC INDEXING TOOL BLOCK
AIR OPERATED WORK DRIVER
2ND PASS, TRACE THREAD DIA. ONLY
1ST PASS, TRACE FULL LENGTH (LEAVE STOCK ON THREADED DIA.)
1-5/8" DIA. 16 THREADS
TRACE OUTSIDE FACE CONTOURS
THREAD ROLLING ATTACHMENT
LEFT HAND OVERHEAD TRACER SLIDE (SHOWN 90° OUT OF POSITION)
FRONT SQUARING ATTACHMENT

Fig. 2. Tooling layout for simultaneously turning and threading on Seneca Falls tracer lathe



Automatic chucking machine showing newly designed air chuck on spindle (left center) announced by the Brown & Sharpe Mfg. Co.

Brown & Sharpe Automatic Chucking Machine

A No. 2 automatic chucking machine is now available from the Brown & Sharpe Mfg. Co., Providence, R. I. Using a newly designed Skinner air chuck mounted on a spindle developed specially for chucking work, this machine can handle irregularly shaped parts, such as forgings, castings, extrusions, and cold-headed parts, as well as simple slugs. The chuck has a 3-inch capacity, and the swing over the cross-slides is 4 inches.

Spindle drive is by means of gears and chains from a 7 1/2-hp motor. Fifteen spindle speeds on the high range, with a top speed of 2095 rpm, are available for those jobs requiring spindle reversal during the cycle. Two higher speeds up to 2905 rpm are available for nonreversing work.

Both automatic and manual controls for operating the chuck are furnished as standard equipment. Semiautomatic or fully automatic loading equipment specially designed for specific parts can be furnished.

A three-jaw chuck is normally provided, although a two-jaw chuck is also available. Standard equipment, in addition to the six-station turret and the two cross-slides, also includes a spindle brake on neutral for loading purposes. A third, vertical slide can be furnished.

The machine uses the same cams, tools, and tool-holders as those employed on the No. 2 Brown & Sharpe automatic screw machine, with a larger capacity turning tool being made available for diameters in excess of 1 1/4 and up to 4 inches. Many of the standard automatic screw machine attachments may be used.

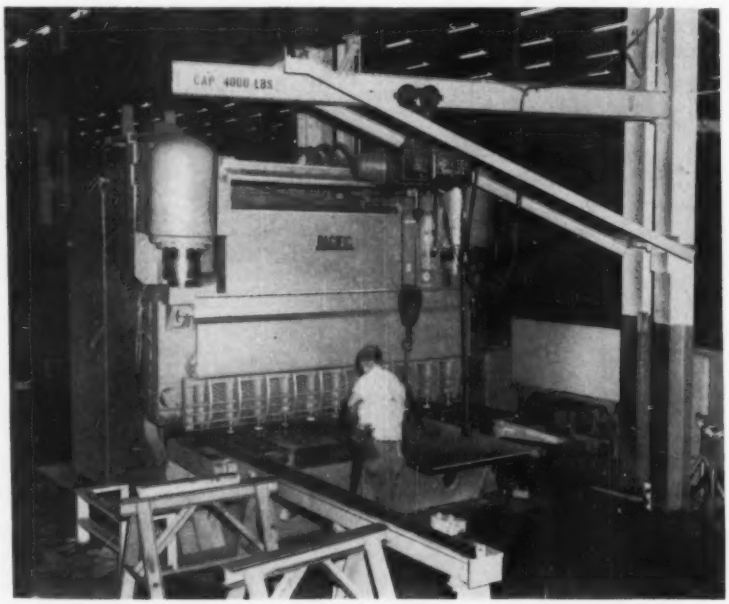
Circle 588 on Readers' Service Card

Heavy-Plate Shear Adjustable for Cutting Light Material

The adjustable rake angle of a single hydraulic shear makes it possible to cut both heavy plate and narrow strips of light-gage material with minimum bow and twist at the plant of the Caterpillar Tractor Co., Joliet, Ill. By a simple one-minute adjustment, the rake of this massive 1 1/2-inch shear built by the Pacific Industrial Mfg. Co., Oakland, Calif., can be set to the most efficient cutting angle for any thickness of material. With similarly rapid adjustment of the knife clearance, this machine—said to be the largest adjustable rake shear ever built—cuts a complete range of metals from light sheet to 1-inch plate to an accuracy of 0.030 inch over the entire length of the 10-foot bed. Shorter pieces over 1 inch thick are cut to 0.125-inch accuracy. Shockless, hydraulic pressure extends knife life.

Circle 589 on Readers' Service Card

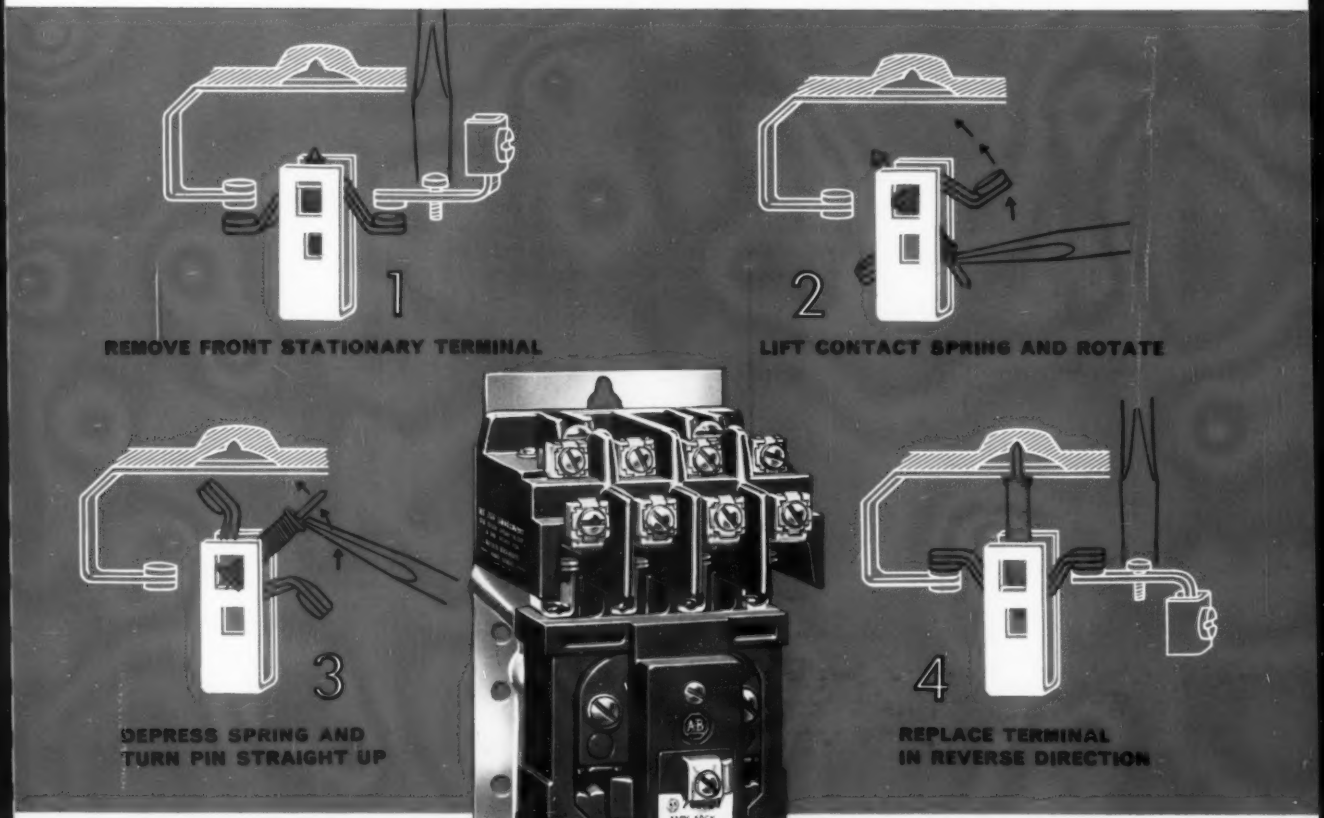
(*This section continued on page 163*)



Pacific heavy-plate shear that can be adjusted to cut light-gage material

Four simple steps to contact changeover

Total time—not more than 60 seconds

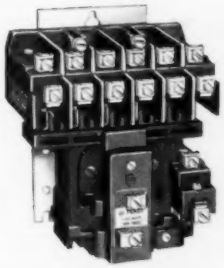


Converts from N.O. to N.C. (or vice versa) in 60 SECONDS!

You'll be truly amazed at the ease of converting the contacts on these Allen-Bradley Bulletin 700 Type BR relays. Using only a screwdriver, as shown above, the contacts can be changed from N.O. to N.C. (or vice versa) in four easy steps—that take only *60 seconds!* Such convenient flexibility is a "natural" for reducing relay inventories.

The Type BR relays are built to provide *many millions* of trouble free operations. With the built-in permanent air gap, magnetic sticking is impossible. And the molded coil is impervious to *all* harmful atmospheres. Of course, the double break, silver contacts *never* need attention. If you use relays, there are money savings for you in the Type BR relay line!

AUXILIARY CONTACTS EASILY ADDED



Type BR relays are available with 2, 3, 4, or 6 poles—but as a valuable bonus, one or two fully rated poles can be added to the base of each relay—even in the field. It's a simple addition that takes only moments.

ALLEN-BRADLEY

Member of NEMA

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis. • In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

QUALITY MOTOR CONTROL

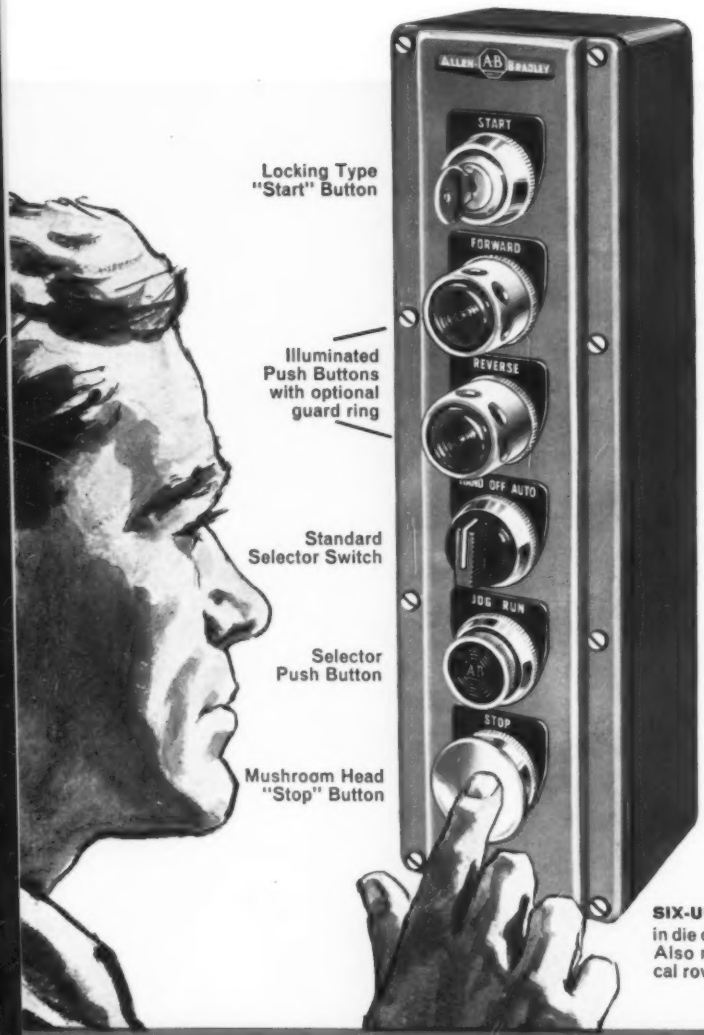
5-61-RM

BE SURE YOU GET

Quality Appearance Quality Operation

Specify Allen-Bradley's line of **OILTIGHT CONTROL STATIONS**

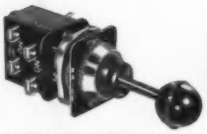
Allen-Bradley oiltight units and stations harmonize with the trim lines of modern machine tools —they look as if they were a part of the machine. Also, from the wide selection of control units, you'll be able to satisfy every operating requirement. A-B control units are positively oiltight—impossible for oils and cutting fluids to foul the contacts. And the silver contacts assure reliable operation. The rugged construction and generous wiring room of all A-B stations are valued by the installation engineer. Insist on Allen-Bradley pilot control units and stations—you can't make a mistake! Send for Publication 6090.



FLUSH HEAD
push button, also made with extended head.

WING LEVER PUSH BUTTON
Combines push button and selector switch.

PUSH-TO-TEST PILOT LIGHT
Six different color lenses available.



4-WAY SELECTOR SWITCH
Also furnished for 2-way operation.

PILOT LIGHT
Transformer or full voltage types.

DOUBLE CIRCUIT
Has 2 N.O. or 2 N.C. sets of contacts.

PILOT LIGHT CLUSTER
Four lights of different colors in one unit.

SELECTOR SWITCH
With coin slot operator. Other operators available.

CONVENIENCE RECEPTACLE
For plugging in work light or small tools.

SPECIAL CONTROL CONSOLES
can be furnished to meet your exact operating requirements.

SIX-UNIT CONTROL STATION
in die cast aluminum housing. Also made with up to 4 vertical rows with 4 units per row.

5-61-RM

ALLEN-BRADLEY

Member of NEMA

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis. • In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

QUALITY MOTOR CONTROL

CAPACITY OF ROUND TANKS

For One Foot in Depth

Dia. of Tank	No. U. S. Gals.	Cubic Feet	Dia. of Tank	No. U. S. Gals.	Cubic Feet	Dia. of Tank	No. U. S. Gals.	Cubic Feet
ft. in.			ft. in.			ft. in.		
1	5.87	.785	5 8	188.66	25.22	19	2120.9	283.53
1 1	6.89	.922	5 9	194.25	25.97	19 3	2177.1	291.04
1 2	8.00	1.069	5 10	199.92	26.73	19 6	2234.0	298.65
1 3	9.18	1.227	5 11	205.67	27.49	19 9	2291.7	306.35
1 4	10.44	1.396	6	211.51	28.27	20	2350.1	314.16
1 5	11.79	1.576	6 3	229.50	30.68	20 3	2409.2	322.06
1 6	13.22	1.767	6 6	248.23	33.18	20 6	2469.1	330.06
1 7	14.73	1.969	6 9	267.69	35.78	20 9	2529.6	338.16
1 8	16.32	2.182	7	287.88	38.48	21	2591.0	346.36
1 9	17.99	2.405	7 3	308.81	41.28	21 3	2653.0	354.66
1 10	19.75	2.640	7 6	330.48	44.18	21 6	2715.8	363.05
1 11	21.58	2.885	7 9	352.88	47.17	21 9	2779.3	371.54
2	23.50	3.142	8	376.01	50.27	22	2843.6	380.13
2 1	25.50	3.409	8 3	399.88	53.46	22 3	2908.6	388.82
2 2	27.58	3.687	8 6	424.48	56.75	22 6	2974.3	397.61
2 3	29.74	3.976	8 9	449.82	60.13	22 9	3040.8	406.49
2 4	31.99	4.276	9	475.89	63.62	23	3108.0	415.48
2 5	34.31	4.587	9 3	502.70	67.20	23 3	3175.9	424.56
2 6	36.72	4.909	9 6	530.24	70.88	23 6	3244.6	433.74
2 7	39.21	5.241	9 9	558.51	74.66	23 9	3314.0	443.01
2 8	41.78	5.585	10	587.52	78.54	24	3384.1	452.39
2 9	44.43	5.940	10 3	617.26	82.52	24 3	3455.0	461.86
2 10	47.16	6.305	10 6	640.74	86.59	24 6	3526.6	471.44
2 11	49.98	6.681	10 9	678.95	90.76	24 9	3598.9	481.11
3	52.88	7.069	11	710.90	95.03	25	3672.0	490.87
3 1	55.86	7.467	11 3	743.58	99.40	25 3	3745.8	500.74
3 2	58.92	7.876	11 6	776.99	103.87	25 6	3820.3	510.71
3 3	62.06	8.296	11 9	811.14	108.43	25 9	3895.6	520.77
3 4	65.28	8.727	12	846.03	113.10	26	3971.6	530.93
3 5	68.58	9.168	12 3	881.65	117.86	26 3	4048.4	541.19
3 6	71.97	9.621	12 6	918.00	122.72	26 6	4125.9	551.55
3 7	75.44	10.085	12 9	955.09	127.68	26 9	4204.1	562.00
3 8	78.99	10.559	13	992.91	132.73	27	4283.0	572.66
3 9	82.62	11.045	13 3	1031.50	137.89	27 3	4362.7	583.21
3 10	86.33	11.541	13 6	1070.80	143.14	27 6	4443.1	593.96
3 11	90.13	12.048	13 9	1110.80	148.49	27 9	4524.3	604.81
4	94.00	12.566	14	1151.50	153.94	28	4606.2	615.75
4 1	97.96	13.095	14 3	1193.00	159.48	28 3	4688.8	626.80
4 2	102.00	13.635	14 6	1235.30	165.13	28 6	4772.1	637.94
4 3	106.12	14.186	14 9	1278.20	170.87	28 9	4856.2	649.18
4 4	110.32	14.748	15	1321.90	176.71	29	4941.0	660.52
4 5	114.61	15.321	15 3	1366.40	182.65	29 3	5026.6	671.96
4 6	118.97	15.90	15 6	1411.50	188.69	29 6	5112.9	683.49
4 7	123.42	16.50	15 9	1457.40	194.83	29 9	5199.9	695.13
4 8	127.95	17.10	16	1504.10	201.06	30	5287.7	706.86
4 9	132.56	17.72	16 3	1551.40	207.39	30 3	5376.2	718.69
4 10	137.25	18.35	16 6	1599.50	213.82	30 6	5465.4	730.62
4 11	142.02	18.99	16 9	1648.40	220.35	30 9	5555.4	742.64
5	146.88	19.63	17	1697.90	226.98	31	5646.1	754.77
5 1	151.82	20.29	17 3	1748.20	233.71	31 3	5737.5	766.99
5 2	156.83	20.97	17 6	1799.30	240.53	31 6	5829.7	779.31
5 3	161.93	21.65	17 9	1851.10	247.45	31 9	5922.6	791.73
5 4	167.12	22.34	18	1903.60	254.47	32	6016.2	804.25
5 5	172.38	23.04	18 3	1956.80	261.59	32 3	6110.6	816.86
5 6	177.72	23.76	18 6	2010.80	268.80	32 6	6205.7	829.58
5 7	183.15	24.48	18 9	2065.50	276.12	32 9	6301.5	842.39

31.5 Gals. = 1 Bbl. 231 Cu. Ins. = 1 Gal. 1 Cu. Ft. = 7.48 Gals.

To find the capacity of round tanks greater than the largest given in the table, look for a tank of one-half of the given size and multiply its capacity by 4, or one of one-third its size and multiply its capacity by 9, etc.

For rectangular tanks, multiply the length by the width by the depth and divide by 231.

For elliptical tanks, multiply the length by the short diameter by the long diameter by .0339 and divide by 231.

Courtesy of Peter A. Frasse & Co., Inc.

COMBINED STAINLESS STEEL ANALYSES SPECIFICATIONS

AISI Type Number or Armco Special Grade	Carbon (Max.)	Mang. (Max.)	Phos. (Max.)	Sulfur (Max.)	Silicon (Max.)	Chromium	Nickel	Other Elements	Similar SAE Number	Similar AMS Number
201	0.15	5.50/ 7.50	0.060	0.030	1.00	16.00/18.00	3.50/ 5.50	N 0.25 Max.	——	——
202	0.15	7.50/10.00	0.060	0.030	1.00	17.00/19.00	4.00/ 6.00	N 0.25 Max.	——	——
301	0.15	2.00	0.045	0.030	1.00	16.00/18.00	6.00/ 8.00	——	30301	{5515C, 5516E, 5517D, 5518C
302	0.15	2.00	0.045	0.030	1.00	17.00/19.00	8.00/10.00	——	30302	{5519E, 5636A, 5637A, 5688C
302B	0.15	2.00	0.045	0.030	2.00/3.00	17.00/19.00	8.00/10.00	——	——	——
303	0.15	2.00	0.020	0.15 Min.	1.00	17.00/19.00	8.00/10.00	[a]Mo 0.60 Max.	30303F	5640E, 5641A, 5738
303Se	0.15	2.00	0.020	0.060	1.00	17.00/19.00	8.00/10.00	Se 0.15 Min.	30303F	5640E, 5641A, 5738
304	0.08	2.00	0.045	0.030	1.00	18.00/20.00	8.00/12.00	——	30304	{5513, 5560D, 5565D, 5566C
304L	0.03	2.00	0.045	0.030	1.00	18.00/20.00	8.00/12.00	——	——	{5639A, 5697 5511A, 5647
305	0.12	2.00	0.045	0.030	1.00	17.00/19.00	10.00/13.00	——	30305	5514A
307	0.15	3.75/4.75	0.045	0.030	1.00	19.00/22.00	9.00/10.50	——	——	——
308	0.08	2.00	0.045	0.030	1.00	19.00/21.00	10.00/12.00	——	30308	——
309	0.20	2.00	0.045	0.030	1.00	22.00/24.00	12.00/15.00	——	30309	——
309S	0.08	2.00	0.045	0.030	1.00	22.00/24.00	12.00/15.00	——	——	5523, 5574, 5650
310	0.25	2.00	0.045	0.030	1.50	24.00/26.00	19.00/22.00	——	30310	5521B, 5572B, 5577A, 5651C
310S	0.08	2.00	0.045	0.030	1.50	24.00/26.00	19.00/22.00	——	——	——
314	0.25	2.00	0.045	0.030	1.50/3.00	23.00/26.00	19.00/22.00	——	——	5522B, 5652A
316	0.08	2.00	0.045	0.030	1.00	16.00/18.00	10.00/14.00	Mo 2.00/3.00	30316	5524B, 5573B, 5648B, 5690E
316L	0.03	2.00	0.045	0.030	1.00	16.00/18.00	10.00/14.00	Mo 2.00/3.00	——	——
316F	0.10	2.00	——	——	1.00	16.00/18.00	10.00/14.00	P or S 0.07 Min. Mo 1.75/2.50	——	5649
317	0.08	2.00	0.045	0.030	1.00	18.00/20.00	11.00/15.00	Mo 3.00/4.00	30317	——
D319	0.07	2.00	0.045	0.030	1.00	17.50/19.50	11.00/15.00	Mo 2.25/3.00	——	{5510F, 5557A, 5559, 5570G
321	0.08	2.00	0.045	0.030	1.00	17.00/19.00	9.00/12.00	Ti 5 x C Min.	30321	{5576B, 5645F, 5689
325	0.25	2.00	0.045	0.030	1.00	7.00/10.00	19.00/23.00	——	30325	——
329	0.20	2.00	0.045	0.030	1.00	25.00/30.00	3.00/ 5.00	Mo 1.00/1.50	30329	——
347	0.08	2.00	0.045	0.030	1.00	17.00/19.00	9.00/13.00	Cb +Ta 10 x C Min.	30347	{5512B, 5556A, 5558, 5571B
347F Se	0.08	2.00	0.045	0.030	1.00	17.00/19.00	9.00/12.00	Cb +Ta 10 x C Min. +Se	——	{5575F, 5646D ——
348	0.08	2.00	0.045	0.030	1.00	17.00/19.00	9.00/13.00	Cb +Ta 10 x C Min. Ta 0.10 Max., Co 0.20 Max.	——	——
16-18	0.08	1.00	0.040	0.030	1.00	15.00/17.00	17.00/20.00	——	——	——
17-4 PH	0.07	1.00	0.040	0.030	1.00	15.50/17.50	3.00/ 5.00	Cu 3.00/5.00 Cb +Ta 0.15/0.45	——	5643D
17-7 PH	0.09	1.00	0.040	0.030	1.00	16.00/18.00	6.50/ 7.75	Al 0.75/1.50	——	{5528A, 5529A, 5568, 5644A
PH15-7 Mo	0.09	1.00	0.040	0.030	1.00	14.00/16.00	6.50/ 7.75	Mo 2.00/3.00 Al 0.75/1.50	——	{5673A ——
17-10 P	0.15	1.00	0.20/0.30	0.030	1.00	16.00/18.00	9.00/11.00	——	——	——
12-2 W	0.20	1.00	0.040	0.030	1.00	12.00/14.00	1.75/ 2.25	W 2.50/3.50	——	——
22-4-9	0.45/0.60	7.00/10.00	0.045	0.120	1.00	20.00/23.00	3.00/ 5.00	N 0.30/0.50	——	——
403	0.15	1.00	0.040	0.030	0.50	11.50/13.00	——	——	——	——
405	0.08	1.00	0.040	0.030	1.00	11.50/14.50	——	Al 0.10/0.30	——	——
410	0.15	1.00	0.040	0.030	1.00	11.50/13.50	——	——	51410	5504D, 5591C, 5613C
414	0.15	1.00	0.040	0.030	1.00	11.50/13.50	1.25/ 2.50	——	51414	5615B
416	0.15	1.25	0.060	0.15 Min.	1.00	12.00/14.00	——	[a]Mo 0.60 Max.	51416F	5610E
416Se	0.15	1.25	0.060	0.060	1.00	12.00/14.00	——	Se 0.15 Min.	51416F	5610E
420	Over 0.15	1.00	0.040	0.030	1.00	12.00/14.00	——	——	51420	5506A, 5621
420F	Over 0.15	1.00	——	——	1.00	12.00/14.00	——	P or S 0.07 Min. Zr or Mo 0.60 Max.	51420F	5620B
420F Se	Over 0.15	1.00	——	0.030	1.00	12.00/14.00	——	P or Se 0.07 Min. Zr or Mo 0.60 Max.	51420F	5620B
430	0.12	1.00	0.040	0.030	1.00	14.00/18.00	——	——	51430	5627
430Ti	0.12	1.00	0.040	0.030	1.00	14.00/18.00	——	Ti 6 x C Min.	——	——
430F	0.12	1.25	0.060	0.15 Min.	1.00	14.00/18.00	——	[a]Mo 0.60 Max.	51430F	——
430F Se	0.12	1.25	0.060	0.060	1.00	14.00/18.00	——	Se 0.15 Min.	——	——
431	0.20	1.00	0.040	0.030	1.00	15.00/17.00	1.25/ 2.50	——	51431	5628B
440A	0.60/0.75	1.00	0.040	0.030	1.00	16.00/18.00	——	Mo 0.75 Max.	51440A	5631
440B	0.75/0.95	1.00	0.040	0.030	1.00	16.00/18.00	——	Mo 0.75 Max.	51440B	——
440C	0.95/1.20	1.00	0.040	0.030	1.00	16.00/18.00	——	Mo 0.75 Max.	51440C	5630C
440F	0.95/1.20	1.00	——	——	1.00	16.00/18.00	——	P or S 0.05 Min. Zr or Mo 0.60 Max.	51440F	5632B
440F Se	0.95/1.20	1.00	——	0.030	1.00	16.00/18.00	——	P or Se 0.07 Min.	——	——
442	0.25	1.00	0.040	0.030	1.00	18.00/23.00	——	——	51442	——
446	0.20	1.50	0.040	0.030	1.00	23.00/27.00	——	N 0.25 Max.	51446	——
501	Over 0.10	1.00	0.040	0.030	1.00	4.00/ 6.00	——	Mo 0.40/0.65	51501	5602A
502	0.10	1.00	0.040	0.030	1.00	4.00/ 6.00	——	Mo 0.40/0.65	——	——

[a] At producer's option; reported only when intentionally added.

Courtesy of Peter A. Frasse & Co., Inc.

Drunken Helix Apprehended Electronically!

What is Drunken Helix? In screw threads it is the deviation in the true path of the thread spiral or helix.

This enemy to thread accuracy, this thief of product tolerances, has long been under surveillance by precision gage-makers. But no practical method has been known for quickly taking its measurement.

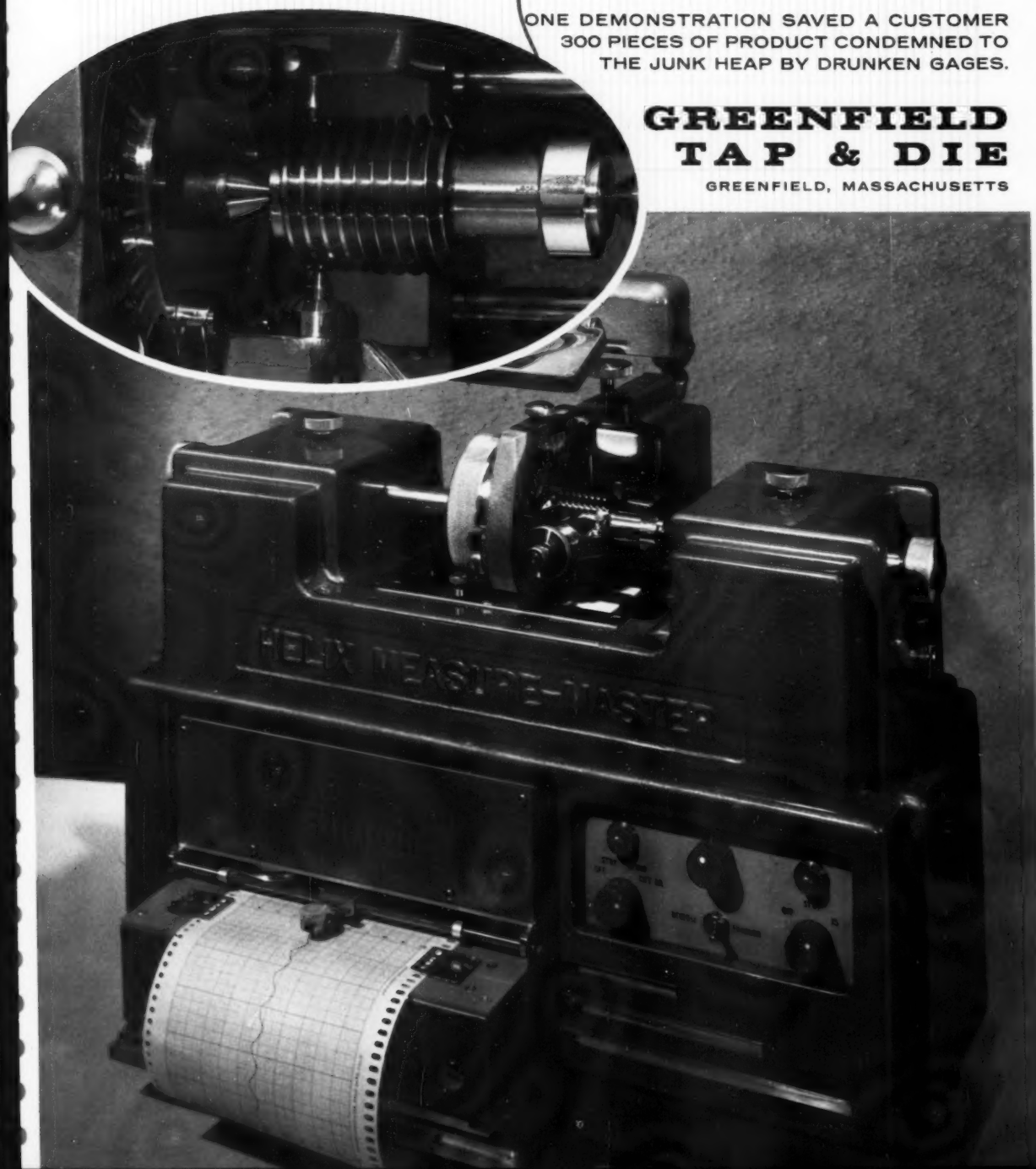
Now, GREENFIELD announces an all electronic detective which not only determines the presence of helix drunkenness but also makes a tape recording of it! Now we can tell the exact amount (.000020" resolution) and the exact location of drunkenness with a permanent record for reference!

Driving probe may be shifted through 90° quadrant to measure drunkenness occurring at other than 180° span. Includes facilities for isolating eccentricity, ovality and other P.D. errors, from drunkenness.

May we send a GREENFIELD gage expert to explain the capabilities of this amazing device?

ONE DEMONSTRATION SAVED A CUSTOMER
300 PIECES OF PRODUCT CONDEMNED TO
THE JUNK HEAP BY DRUNKEN GAGES.

GREENFIELD
TAP & DIE
GREENFIELD, MASSACHUSETTS



why General Mills checks every precision production gear on the S&F gear tester...

General Mills' inspector running a production gear in one of four S & F Testers. Note extreme sensitivity of instrument on Graphotest record.

because...

there's no gear tester as accurate as the S & F

Checking gears by the usual methods just isn't accurate enough to satisfy so precision-minded a producer as the Mechanical Division of General Mills. They know that their gears can be only as accurate as the instruments that test them—and only the S & F Gear Tester measures up to the highest precision standards.

Strong statement you say? Several hundred S & F Testers prove it every day in plants that took their gear accuracy seriously enough to change over to S & F—guaranteed to repeat within .00001".

Ask us to show you why this instrument is revolutionizing gear checking. Or talk to the S & F user near you. We'll send you his name.

KO CO., INC. PRECISION MACHINERY

KURT ORBAN

COMPANY, INC.

42 Exchange Place, Jersey City 2, N. J.

(Latest Developments in Shop Equipment—Continued from Page 156)

Warco Back-Geared Press Brake

A giant-size, 1000-ton press brake capable of handling work exceeding 40 feet in length has been designed and built by the Warco Division of the Federal Machine & Welder Co., Warren, Ohio. This welded-steel, double back-geared twin-drive press brake is now being used to form aluminum siding and roof deck parts by one of the leading aluminum manufacturers. Individual adjustments can be made on each ram connection, making it possible to form tapered parts.

The machine requires a floor space of approximately 151 by 528 inches, and the distance between housing is 450 inches. The slide has an area of 6 by 492 inches and a stroke of 9 inches. The press brake operates at the rates of twelve strokes per minute. It is equipped with a Warco, pneumatic friction clutch and brake with electrical control.

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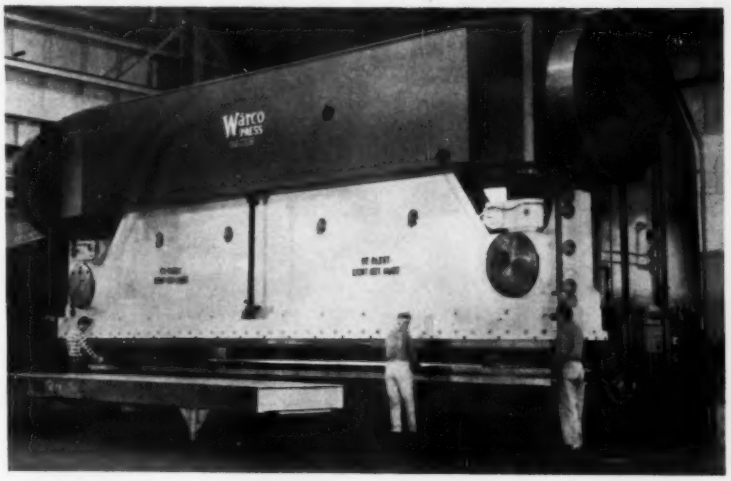


Giant-size Warco press brake handles work over 40 feet in length

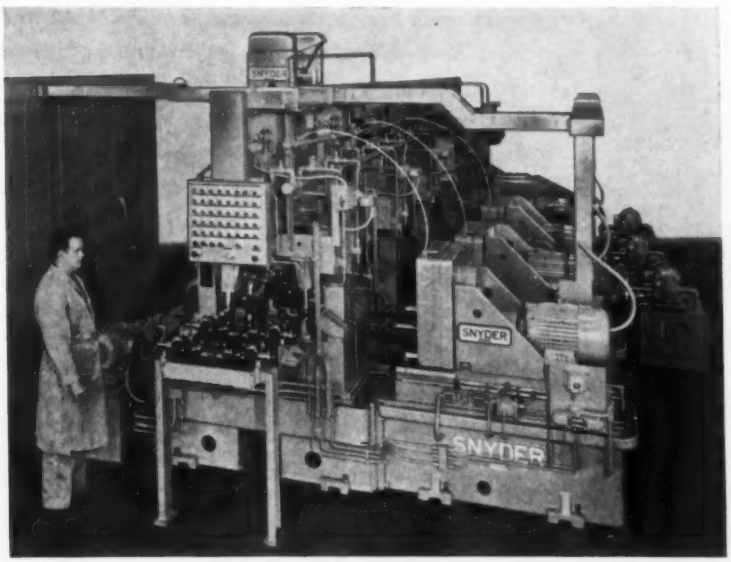
Snyder Transfer Machine for Processing Crankshafts

A special twenty-station building-block type transfer machine that drills, reams, taps, chamfers, and precision-bores seventy-eight automotive engine crankshafts per hour at 100 per cent efficiency has been designed and built by the Snyder Corporation, Detroit, Mich. This 34-foot long machine is made up of five separate machining segments and a motorized chip conveyor. The forged-steel crankshafts are fed through the machining units by a walking-beam type of transfer mechanism. The parts rest on V-blocks at the two outer main-bearing positions. Hydraulically operated overhead vees clamp the parts in each work station. Endwise location is made by a locator at the No. 3 main-bearing position. Radial location of the part is accomplished by an approximate locator on the No. 1 pin and a hydraulically operated clamping vee.

Of particular interest in this machine are the rough and finish precision-boring operations on the center hole in the crankshaft flange, which are performed at Stations 18 and 19. For these machining operations, the parts, rather than the boring tools, are rotated. This assures absolute concentricity between the center hole and the main bearings on which the crankshaft rests.

For the boring operation, the flange-end main bearing of the part rests in vees equipped with carbide inserts. Two rollers on a hydraulically operated overhead clamp hold the part and rotate it during this operation. An in-process gaging operation probe-checks six holes for completeness or detection of broken drills by means of a hydraulically operated probing plate at the eighth station. The machine is made up of a series of welded-steel center bases and Snyder standard cast-iron wing bases and way type slide units with hardened and ground steel ways. The milling heads are

(Continued on page 166)



Snyder twenty-station transfer machine built to process engine crankshafts

MICROHONED* High Pressure

After years of service, the Micromatic Hydrohoner continues to produce bores to precision tolerances. Interlocked controls provide an automatic Microhoning cycle.

Bores are located in Microhoning position by this two-station fixture. It is of the disappearing locating plug type. When all bores are Microhoned, the fixture is indexed to bring another barrel into position and the finished barrel is swung to the load-unload station.

High pressure hydraulic axial piston pumps produced by Dynex Incorporated (Pewaukee, Wisconsin) achieve an overall efficiency of 97%. It is this high efficiency that makes the "Split-Flow" feature of Dynex pumps particularly effective. Characterized by independent, multiple circuitry that uses a single pumping unit, "Split-Flow" is designed to resolve problems in synchronizing feeds and speeds in circuits with unequal loads, or to provide auxiliary circuit requirements. As many separate circuits can be provided as there are pistons.

MICROHONING Provides Precision Bores

To hold the critical running seal between barrel bore and piston, it is mandatory that bore size, geometry, straightness and finish are consistently held to required tolerances. Therefore, Microhoning is specified to generate these prime final characteristics that are essential in attaining high pump efficiency. Emphasizing the importance of the seal is the fact that larger high pressure Dynex pumps must consistently hold a pressure of 6,000 psi.

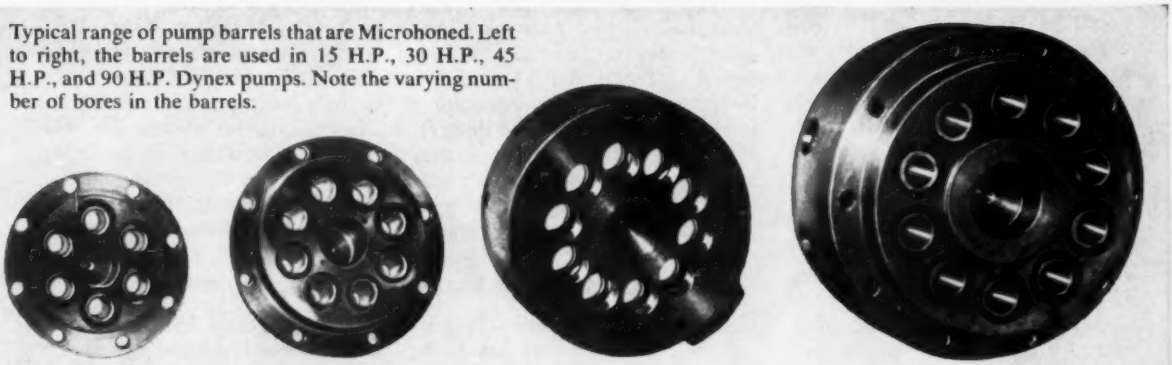
MICROHONING Eliminates Scrap Problem

Significantly, the barrels are the most expensive and critical pump parts to manufacture. If just one of the several bores in each barrel is out of tolerance, the whole barrel is scrapped. Previously used methods involved burnishing and proved unsatisfactory in providing consistent size and geometry, or in maintaining production volume. A rejection or scrap rate of 10% was not unusual. Microhoning has now eliminated the scrap problem by consistently generating bores within the specified tolerances for size, roundness, straightness and surface finish.

*Registered U.S. Pat. Off.

Dynex Pumps Reach 97% Efficiency

Typical range of pump barrels that are Microhoned. Left to right, the barrels are used in 15 H.P., 30 H.P., 45 H.P., and 90 H.P. Dynex pumps. Note the varying number of bores in the barrels.



MICROHONING Assures Production Efficiency

Depending on pump size (1 to 90 H.P. or more) and design, there are six, eight or ten bores in each barrel and Microhoned bores range in diameter from .5936" to .8138" and are approximately 3⅛" long. Also, plans are underway to Microhone another barrel with bores .965" in diameter and 3-3/32" long.

Preceding the Microhoning operation, the bores in the soft steel barrels are reamed and a finish of 60 to 65 microinches (rms) is obtained. Microhoning then removes an average of .0025" stock from the bore diameter in a time cycle of about 50 seconds.

An automatic sizing device (Gage Ring Microsize) controls the bore size within the .0002" tolerance. Also, with Microhoning, the roundness and straightness of the bore are held to a .0001" tolerance, and a surface finish of 10 microinches (rms) is consistently generated.

The use of Microcool "97" cutting fluid permits selecting a Microhoning abrasive coarse enough to cut effectively and still provide the required relatively fine finish.

Because Microhoning assures barrel bores that are consistently held to specified tolerances, the assembly of pistons and barrel is facilitated. Assembly time thus saved is considered by Dynex engineers to be a bonus benefit derived from the Microhoning process.

For further information on MICROHONING, please write to:

DYNEX Plans Expanding the Use of MICROHONING to Other Applications

As a part of a Dynex program to broaden the use of Microhoning, the bores in brake valve housings are scheduled as the next application for this efficient process. Currently, the processing problem is slow production and high scrap rate. Unless a highly skilled operator is used regularly on present method of manual honing, rejects run as high as 50%.

The interrupted bore, in which the spool valve operates, is 1.000" in diameter and 1¼" long; it has a counterbored throat about 1⅞" deep. With proper fixturing and tooling, Microhoning will generate accuracy in this critical bore within the required overall tolerance of .0004", while controlling the surface finish to the specified 32 microinches (rms).

Cutaway view of brake valve housing with spool in position. Open view of housing shows bore surface (with two close, parallel grooves) that is to be Microhoned.

PRECISION PRODUCTION THROUGH MICROHONING
MICRO MATIC

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mounted on a standard counterweighted column.

The center hole in the crankshaft flange is drilled half way to depth in Station 2, and to full depth in Station 3. Four holes are drilled in the flange at Station 8. In Station 10, a keyway is milled, and the six holes are chamfered. A hole is reamed in the flange and another keyway in the part is milled in Station 11. The center hole is chamfered in Station 14, and the four holes in the flange are tapped in the fifteenth station. The center hole is rough precision-bored in Station 18, and finish precision-bored in the succeeding station. The machine occupies a floor space approximately 224 by 404 inches.

Circle 591 on Readers' Service Card

Special Broaches for Army Ordnance Work

The Continental Tool Works Division of Ex-Cell-O Corporation, Detroit, Mich., recently developed a series of broaches designed to reduce costs, speed machining, and improve finish on a tough, high-tensile-strength alloy-steel breech-ring body. The work performed by this equipment at an army ordnance plant consists of machining a T-shaped hole 8 inches wide by 14 1/2 inches long in two broaching operations.

First, that portion of the hole having the smaller width is machined. Only four passes are necessary from roughing to finishing, removing metal to a depth of 1/8 inch per side. After orientating the 800-pound work-piece through 180 degrees, the second operation is performed. Here the wider section of the hole is roughed and finished in eight passes, removing 1/2 inch of stock per side.

The twelve broach assemblies contain eighty precision-ground high-speed-steel inserts, many being over 8 inches wide. Total working travel of each broach is 76 inches, and some broaches require a maximum pull of 40 tons. The illustration shows the 800-pound breech-ring body being loaded in the broaching machine at an Army ordnance plant.

Circle 592 on Readers' Service Card

Precision Turret Lathe with One-Motion Control

A precision turret lathe featuring one-motion control has been introduced by Rivett Lathe & Grinder, Inc., Boston, Mass. This lathe, the second in Rivett's "60 Series," is an entirely new design that offers new features developed to give greater accuracy and higher production rates on initial machining and second operations. With one-motion control, a single lever starts the lathe spindle and selects any speed up to 4800 rpm. The same lever will change speed during operation or instantly stop or reverse the spindle. A push button on the knob of this lever opens and closes a collet or step chuck. Stops may be set for repeating selected speeds. The instantly reversing spindle is valuable for quickly retracting taps and dies.

The automatic indexing turret has hardened steel slides and a head that is supported by large, rigid antifriction bearings. The turret slide passes over the top of the double-tool cross-slide and can be adjusted, both vertically and horizontally, for accurate alignment of turret head to spindle.

A spindle of improved design, which assures true roundness and rigidity, runs in large-diameter superprecision ball bearings fitted to in-line ground mountings. Constant bearing preload, unchanged by speed or heat, holds the spindle rigid against both side and end pressure of cutting tools.

Another feature, the double-bevel bed, positively centers the turret in alignment with headstock, and the large gearing area

Loading breech-ring body for heavy precision broaching

Rivett precision turret lathe with one-motion control

Did you know this about foreign competition?

Foreign manufacturers who are actively competing for markets in the U. S. and throughout the world have enjoyed some real cost advantages in the past. Today they are faced with labor shortages and rising labor costs which are whittling down their profits.

What are they doing to solve these problems? They are turning to the one proved answer that exists today—automated special machinery which CONTROLS production costs and gives them back their competitive edge.

The fact that these operations may be, relatively, smaller than their U. S. counterparts doesn't mean that they can't use automated special machinery successfully. On the contrary, such equipment (already proved practical in limited production in the U. S.) is the *only* solution to many of their cost problems.

As one of the early pioneers in special machinery for low-cost production, Snyder is especially well qualified to explore, with your engineers, the successful use of such equipment in your operation, here or in Europe. It costs nothing to do this and we'll be glad to talk with you.

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prevents below-center wear. A dovetail aligns the double-tool cross-slide and evenly distributes its bearing on the top surface of the bedway as tool pressure pulls against the inverted dovetail.

The double-tool cross-slide has hardened steel slides. Ball detent guides assist the operator in locating the cross-slide in its central position. Adjustable stops control the cross-slide travel. Uneven or nonrigid floor cannot distort the lathe because the bed has three-point mounting on a steel channel isolated from any distortion of cabinet.

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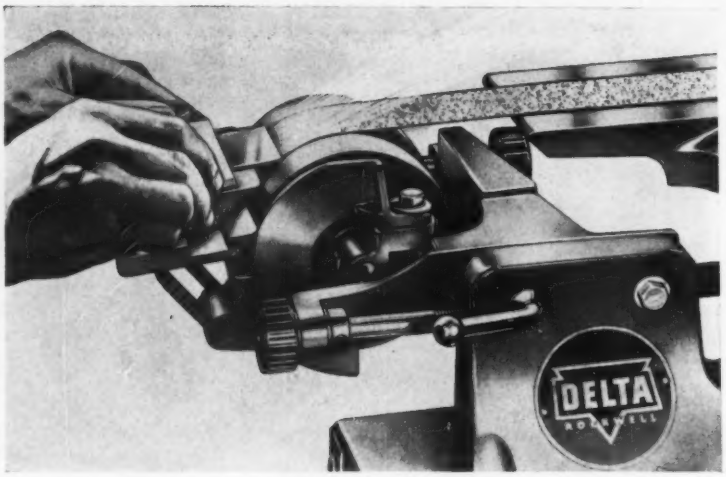


Delta belt and disc finishing machine with blade-grinding attachment

Blade-Grinding Attachment for Belt Type Machines

A blade or knife grinding attachment for the Delta belt and disc finishing machine has been introduced by the Rockwell Mfg. Co.'s Delta Power Tool Division, Pittsburgh, Pa. The attachment permits quick, easy precision sharpening of plane blades, wood chisels, cold chisels, screwdrivers, knives, and other cutting tools on the belt of the finishing machine. The belt does not load up or need dressing, and it practically eliminates tool burning because the grinding heat is rapidly dissipated by the long grinding surface.

A 2-inch wide aluminum-oxide belt, used instead of the standard 4-inch belts for sanding and grinding, is supplied with the attachment. The Delta belt and disc finishing machine, recently introduced, provides a 12-inch disc and a 4-inch belt powered by a single motor. It can handle all finishing operations on wood, metals, and plastics.

Circle 594 on Readers' Service Card

Universal Feed for Flexopresses

Keeping a press running at maximum production capacity is the function of the newest Flexofeed unit developed by Precision Welder & Flexopress Corporation, Cincinnati, Ohio. This unit is designed to feed cut blanks and coil strip interchangeably and equally well. Supplied only as an optional component of Precision's Flexopresses, the feed unit's speed and accuracy match those of the press for high production.

Productivity is particularly increased in press work requiring both coil stock and blanks. Adjustment can be made from one to the other, often in as little time as it takes to switch dies in the press. The Flexofeeds are designed to cover a wide range of feed lengths and speeds, with accuracy down to plus or minus 0.002 inch. On some applications, coil stock can be fed at the rate of 2500 ipm. Blanks are handled at rates as high as 300 per minute.

Adjustment from coil stock to blanks (round or irregular) is made by attaching a blank-holder atop the Flexofeed. The basic

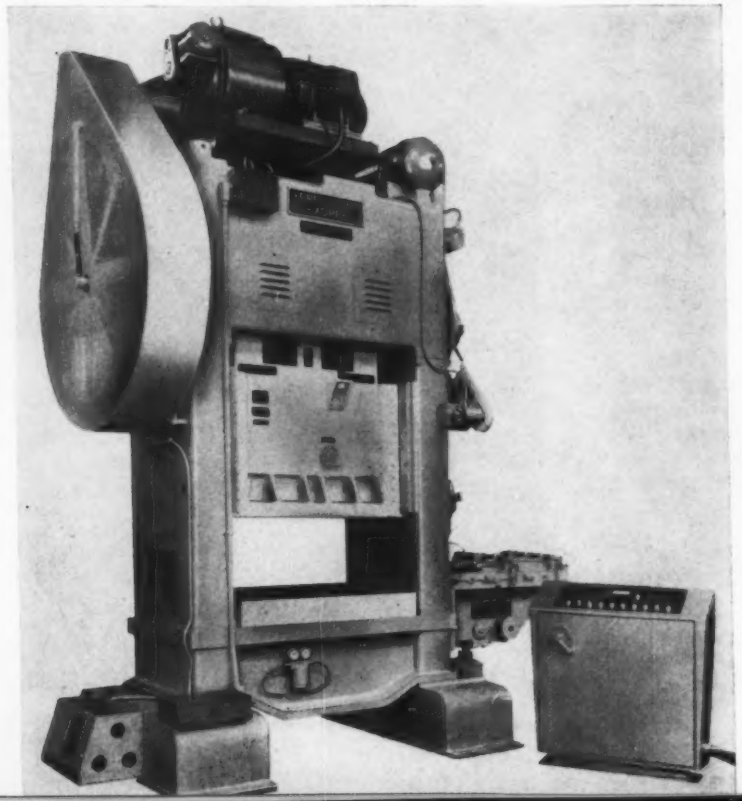
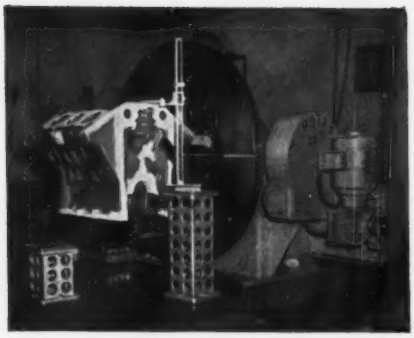
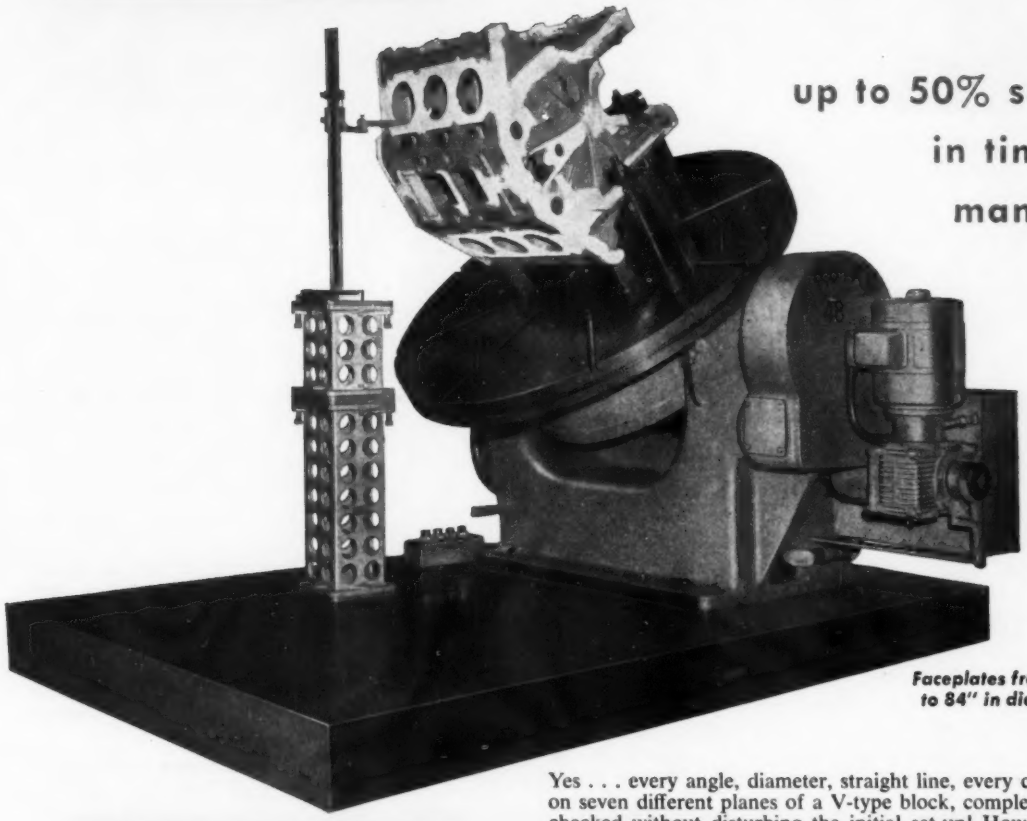


Fig. 1. Flexopress equipped with new Flexofeed for coil strip

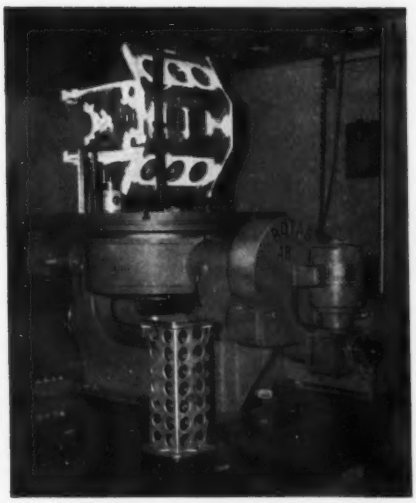


Dimensional check on 7 planes in one set-up!

up to 50% savings in time and manpower



Faceplates from 12" to 84" in diameter



Yes . . . every angle, diameter, straight line, every critical surface, on seven different planes of a V-type block, completely accurately checked without disturbing the initial set-up! How is it possible? With Machine Products' ROTAB universal rotary positioning table, that's how.

And consider the advantages. Previously, this same operation required two men, who had to "wrestle" the block into seven separate set-ups . . . each time re-establishing the locating point. With ROTAB the V-block is loaded on the horizontally positioned table, locating point determined, block clamped in place. Then, ROTAB's precision, movable graduated ring is set at zero to start the angular or radial check, and one man, using motor-powered, push button tilting and rotation runs the entire inspection, saving up to 50% in time, increasing accuracy, reducing rejects.

This, briefly, is what ROTAB has accomplished for one of the nation's leading diesel engine manufacturers.

ROTAB, with its unlimited applications, can do wonders for you, too.

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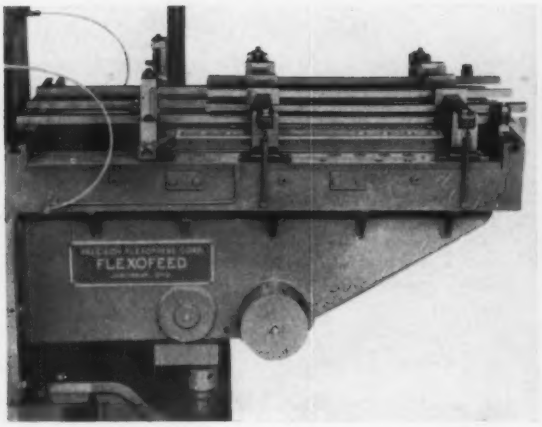


Fig. 2. Gripper fingers replace blank-holder when Flexofeed is set up to handle coil stock

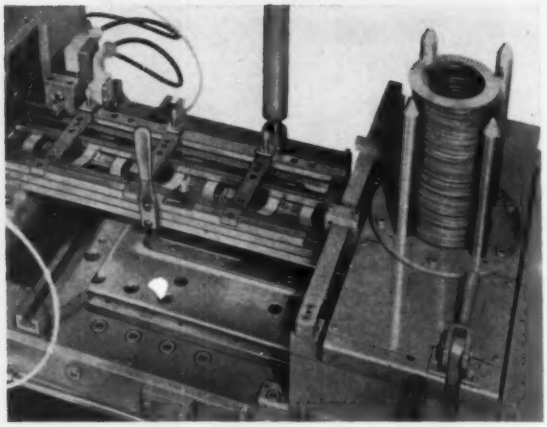


Fig. 3. When Flexofeed is used for feeding blanks, the blank-holder is mounted on the shuttle mechanism

structure of the Flexofeed—frame, gearing, and linkage—remains permanently mounted to the press. It is adjustable for strip up to the full width of the press opening and for feed increments as short or long as desired.

Automobile clutch plates for automatic transmissions are being stamped at a production rate of 270 per minute on a 125-ton straight-side Flexopress equipped with the new Flexofeed. The steel blanks are 5 inches in diameter by 0.040 inch thick. Such accurate high-speed production enables an adequate supply of clutch plates to be made quickly so that the machine can be changed over for progressive stamping of bearing cages from 0.020-inch thick, 2-inch wide coil steel strip, also at the rate of 270 per minute.

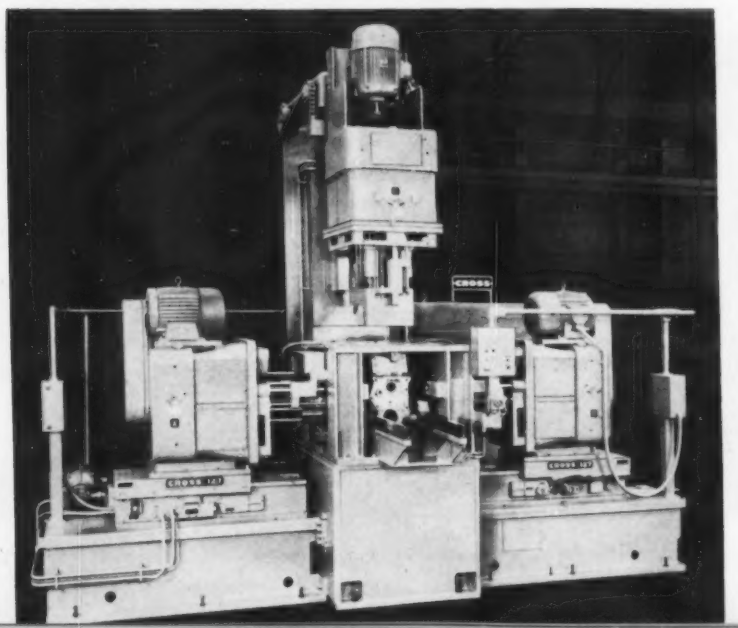
The new Flexofeed is a standard optional component, built for use with high-speed Flexopresses equipped with conventional dies.

Circle 595 on Readers' Service Card

Team of Seven Special Automatic Machines Equipped to Process Tractor Parts

Many advantages of automatic production have been realized on medium-run work without the expense of full automation by employing ingeniously arranged teams or groups of special machine tools. Recently, a tractor manufacturer replaced a large number of general-purpose machine tools with seven machines of the way type designed and built by The Cross Company, Detroit, Mich. Production of heavy cast-iron clutch housings (Fig. 2) on these machines, one of which is shown in Fig. 1, consumes less time and provides greater flexibility and a higher degree of accuracy than was possible with the machine tool equipment previously used.

Fig. 1. Cross machine in which work is positioned on rails by a hoist and manually pushed against stop. Clamping is hydraulic. This is one of seven machines arranged in a group to process tractor clutch housings

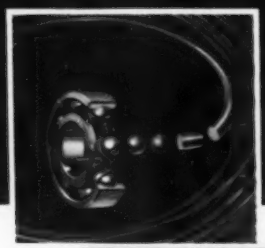


The new machines were introduced at this time because the clutch-housing design has been made more complex and is now produced in six styles from two different lengths of castings. General-purpose machines, used when the parts were comparatively simple, could not compete with the automatic, multiple-spindle operations on the two- and three-way machines. The seven new machines—each with a total cycle time of about three minutes—are run by the equivalent of three and one-half operators.

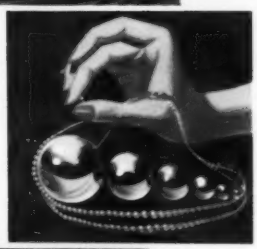
Machines operating on the same faces of the work-piece are installed across the aisle from each other so that the work-pieces follow a zig-zag course. Three styles of housings go through all seven

hoover quality

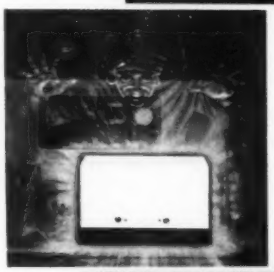
. . . CONTROLLED FROM START TO FINISH



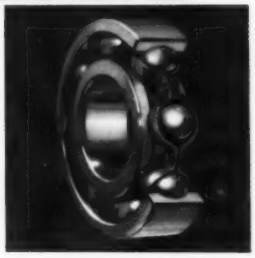
High quality chrome alloy steel wire is produced by the Cuyahoga Steel and Wire Division of Hoover Ball and Bearing Company.



Micro-Velvet balls are produced in the Hoover Ball Division plants in Middletown, Ohio, and Erwin, Tennessee.



Hoover is actively engaged in the development of an expanded line of non-destructive electronic inspection equipment.



Hoover Quality bearings are the final result of the combined know-how of highly specialized, yet integrated Hoover divisions.

Hoover Quality, widely recognized by bearing users, is the result of complete control of every step in the manufacture of bearings.

Specialized knowledge gained through the operation of its own wire drawing mill aids Hoover in setting and controlling the quality standards of wire from which balls are made.

As America's leading producer of balls, Hoover has the experience and equipment it takes to make balls of exceptional quality. *Micro-Velvet* balls used in Hoover bearings are accurate within millionths of an inch!

And Hoover utilizes exclusive processes that assure product superiority. *Hoover Honed* raceways are super smooth, superbly finished. Testing and inspection at various stages of manufacturing are accomplished with specially designed equipment. Even non-destructive electronic inspection is employed.

Hoover Quality is the result of complete control . . . from start to finish.

hoover

BALL AND BEARING COMPANY

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Zone Sales Offices and Warehouses	8581 South Chicago Ave., Chicago 17, Illinois
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	2020 South Figueroa, Los Angeles 7, California

Micro-Velvet and *Hoover Honed* are Hoover Trademarks.

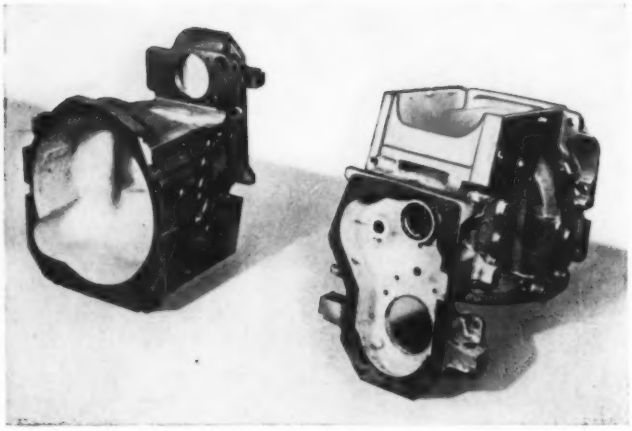


Fig. 2. Holes in these tractor clutch housings were processed on special Cross equipment. Variations among the six different styles of housings are in hole sizes and patterns, and in the length of castings

machines, while the three others are finished by the first six machines. There is sufficient space between machines for banking partially finished parts in anticipation of down time for tool changes on any machine. Because of the proximity of holes on the various work-piece faces, two three-way machines drill holes in the right side, left side, and top. One two-way machine rough-bores openings approached from the front and rear faces, and another two-way machine finishes them. The seventh machine drills and bores the top, right side, and left side of selected parts.

Individual machines can be quickly set up for the two different lengths of castings and the various hole sizes and patterns of the six housing styles. Standard slip-spindle heads are used on the drilling machine so that correct drills can easily be positioned for each part. Operators set up each machine with a check list to prevent incorrect spindles and drills from being used. The bushing plates on several heads are adjustable to compensate for different-length castings. This tooling will accommodate all of the housing styles currently produced and will take care of future product changes as well.

The two boring machines have been designed for production flexibility even if no product changes occur. Each machine has two pairs of heads and a shuttle-mounted fixture. All roughing operations are now done for either length casting in one machine, and all finishing operations are done in the other. Operations for one length casting are done in the front shuttle position, and operations on the other casting are done in the back shuttle position.

Center spindles, Fig. 3, on the right-hand heads in both boring machines bore a large internal hole, and at the end of the feed stroke, a generating tool faces an internal surface. Triangular throwaway carbide inserts are used for both the boring and facing cuts. Two spindles on the same heads accurately bore two dowel holes but retract as soon as the boring feed stroke is completed so that tools do not run idle in the holes during the facing operations.

Dundick "Imperial" Coolant Filter

An improved 1961 model "Imperial" coolant filter incorporating devices developed to save time, labor, and cutting fluids, as well as improve the quality of ground work, has been introduced by Dundick Tool Works, Inc., Chicago, Ill.

With the addition of a smaller manifold plate, this coolant filter is said to make remarkable savings in the grinding machine operator's time. In using the filter, a special compound is added to the coolant to aid the filtering action of a finely woven wire-mesh screen. As a result, all sludge, dirt, grit, metal particles, and other suspended foreign matter down to 1 micron in size are effectively trapped by the caked filters.

Circle 596 on Readers' Service Card

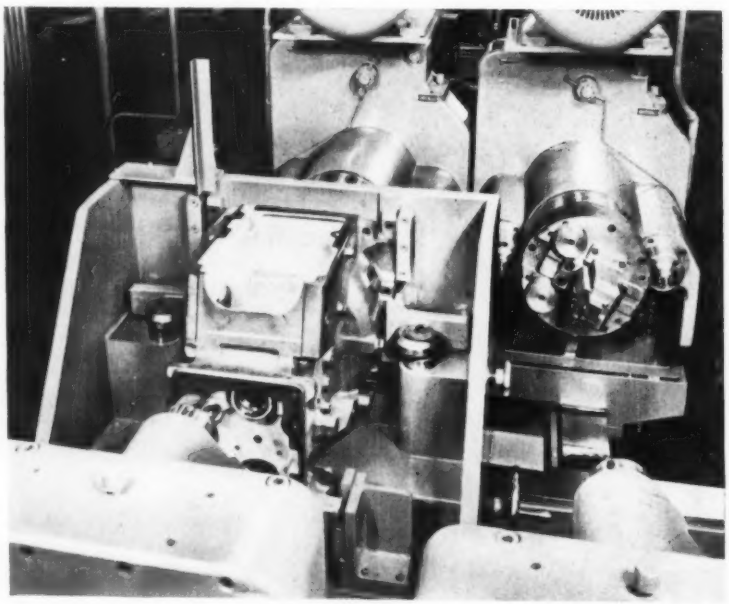
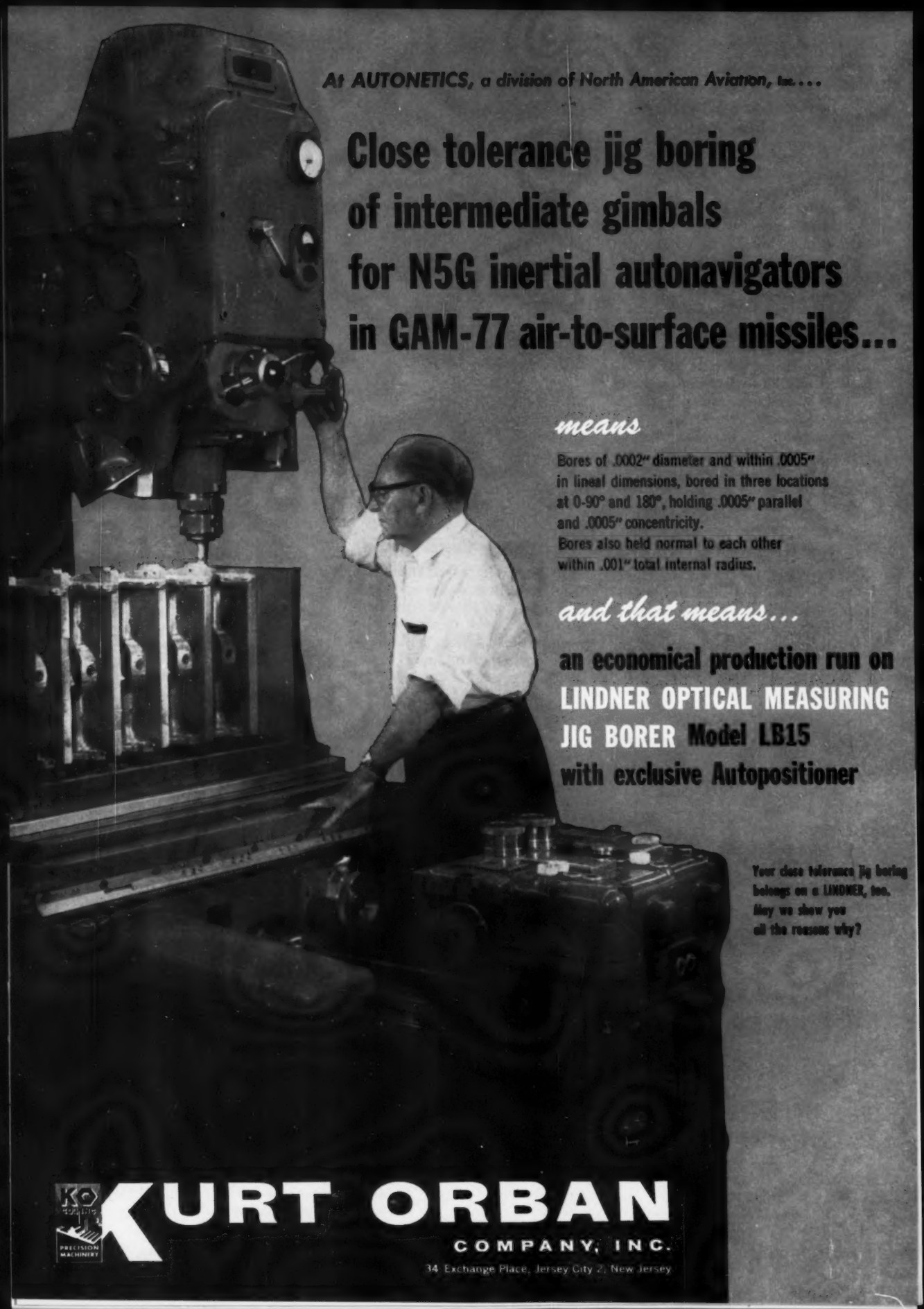


Fig. 3. Cross tool equipment that finishes large central bore, generates faces on an internal surface, and at the same time bores two dowel holes in accurate relationship to each other in tractor clutch housings



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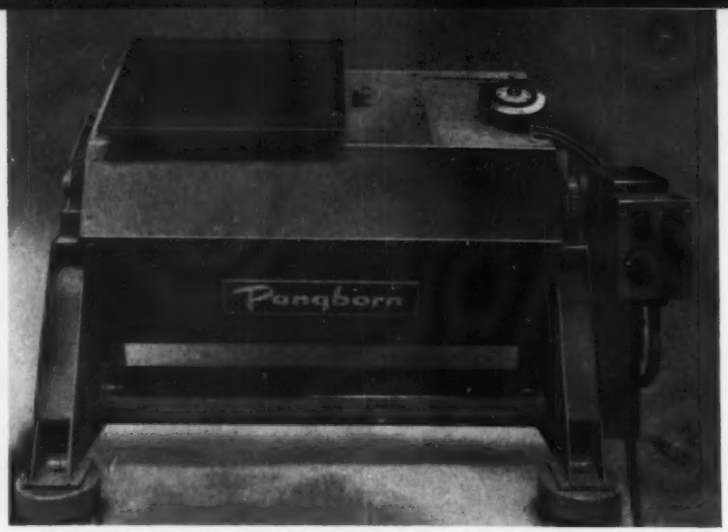
Pangborn Vibratory Finishing Machine

A compact, self-contained vibratory finishing machine with a work-container capacity of 1 1/2 cubic feet has been introduced by the Pangborn Corporation, Hagerstown, Md. Designed as a production unit for finishing small parts, this 1 1/2 YA machine is suitable for a variety of applications on metal, plastic, and ceramic items. It embodies all the exclusive features introduced in earlier models. In addition, it has a conveniently located mechanical motion control for infinite variation of frequency over the available range with the machine running.

The rubber-lined work container holds up to 500 pounds of media and work-pieces and is supported by a system of air cushions. Amplitude, as well as frequency, is variable. When placed on air-cushioned floor mounts, no vibration is transmitted to the floor.

Circle 597 on Readers' Service Card



Vibratory finishing machine introduced by the Pangborn Corporation

Red Ring Gear-Shaving Machines with New Cutter-Heads

Improved models of Red Ring gear-shaving machines for finishing the tooth surfaces on spur and helical gears up to 18-inch pitch diameter have been announced by the National Broach & Machine Co., Detroit, Mich. The cutter-heads on the improved machines, Fig. 1, have been designed to provide long wear life, positive ball-bearing preloads, maximum ease of cutter installation, and maximum freedom of rotation.

With the new cutter-head design, Fig. 2, the shaving-cutter nut is loosened or tightened with the outboard support bearing in place. This avoids the possibility of bending the cutter shaft or brinelling the bearings when tightening or loosening the cutter nut with a wrench. Five preloaded ball bearings are used to support the cutter shaft in the head. A duplex arrangement is used at the rear and a triplex at the front of the shaft.

(Continued on page 176)

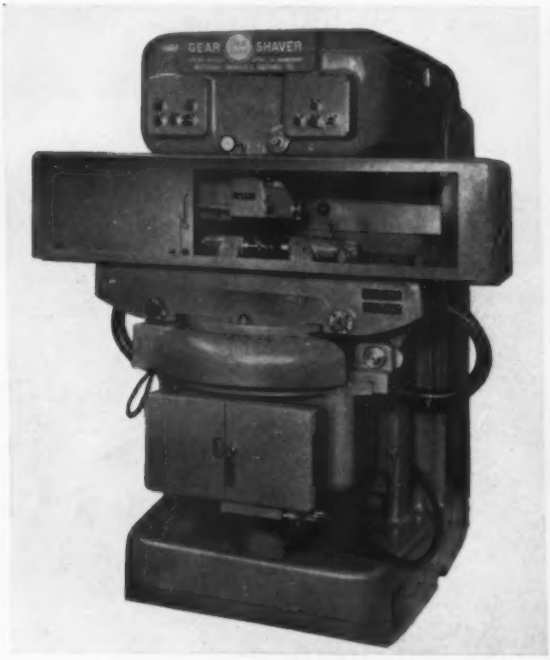


Fig. 1. Improved Red Ring gear-shaving machine equipped with newly designed cutter-head

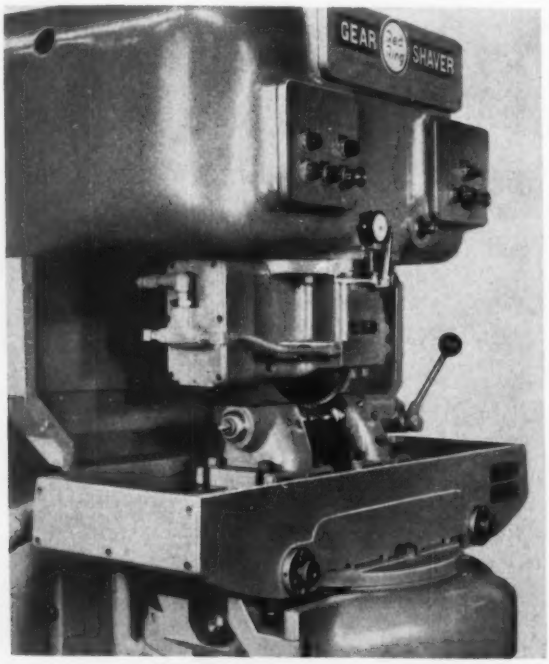


Fig. 2. Close-up of cutter-head installed on a Red Ring Model GCU gear-shaving machine

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For more data circle this page number on card at back of book

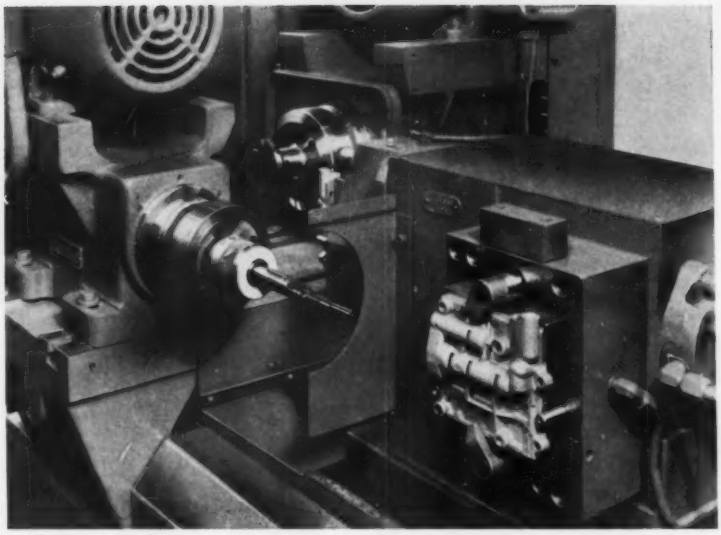
The new cutter-head is made in two sizes that accommodate either 9-inch maximum or 12-inch maximum diameter cutters. The head is utilized on improved models of Red Ring Model GCU 8-, 12-, and 18-inch gear shaving machines. The Model GCU is a universal machine that permits both conventional and diagonal shaving operations to be performed in conjunction with an automatic differential upfeed mechanism.

Circle 598 on Readers' Service Card

Boring Machine Equipped to Process Die-Cast Automotive Part

A single-end precision boring machine recently built by the Ex-Cell-O Corporation, Detroit, Mich., fly-cuts a joint face and step bore-reams an aluminum die-cast automotive transmission part in one operation. The automatic cycle includes a rapid table movement to the left. Here the transversely mounted rear spindle performs a fly-cutting operation while step reaming is accomplished at the front station. At the end of the cycle, the partially finished component clamped in the rear station is reloaded at the front, and another part—semifinished at a previous operation—is loaded at the rear position. Gross production is nearly 150 parts per hour.

Standard Ex-Cell-O precision spindles equipped with carbide-tipped cutting tools perform these precision finishing operations. The five bored diameters are held consistently concentric within 0.0005-inch true indicator reading.



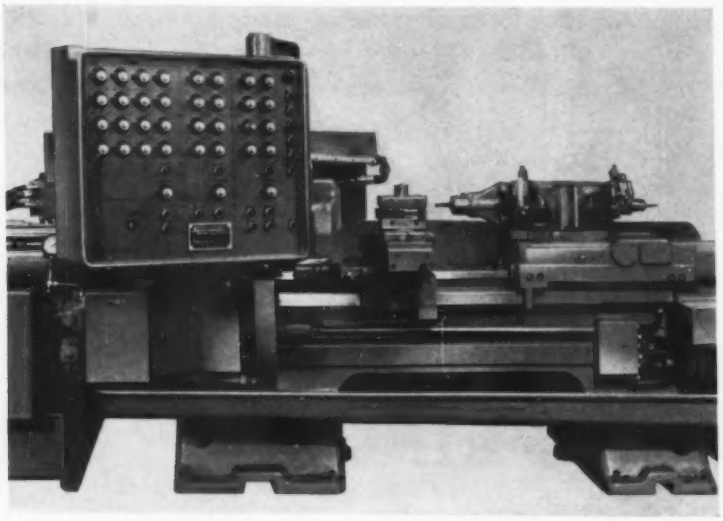
Ex-Cell-O precision boring machine equipped to process automotive part

Circle 599 on Readers' Service Card

Specialmatic Shopman's Numerical-Control System

A full numerical positioning control plus complete manual adjustment for error correction, tool wear, or material variations has been announced by Specialties, Inc., Syosset, N. Y. This equipment provides a highly versatile machine tool control system combination called Specialmatic. In effect, it converts the turret lathe into a single-spindle automatic adapted for short runs. As a "shopman's control system" it requires no external programming of tape or cards, and is said to reduce setup time for short runs to approximately half that required for conventional turret lathes. Production is also claimed to be more than doubled when turret lathes with this new control are used.

Point-to-point rectilinear control of feed rates and dimensional end points at the control panel on the machine tool, plus a built-in logical programming system, enables the setup man to work directly from the numerical dimensions on the blueprint. The outstanding characteristic of the Specialmatic system is that it enables the know-how of the operator to be combined at the machine tool with the speed of setup and operation offered by numerical control. Once a setup is satisfactory, only an unskilled worker is needed for loading and chip removal. Specialmatic control systems are readily adapted to turret lathes, boring machines, grinders, welders, flame cutters, millers,



Numerical-control system announced by Specialties, Inc.

Revere helps "fit the metal to the job"

AND A COMMUTATOR MANUFACTURER SAVES ON BOTH MATERIAL COSTS AND OVERALL COSTS WHILE PRODUCING A SUPERIOR PRODUCT

The hub of the small commutator you see above originally was made of a ferrous metal. Certain problems cropped up due to the fact that the rod from which the hubs were fabricated, not only had to be drilled, but it also had to be able to withstand a flanging operation. The engineering department of Dayton Precision Manufacturing Company called in one of Revere's Technical Advisors for consultation.

After a thorough study of the problem Revere Brass Rod of a certain alloy was recommended and samples were furnished. The machinability of the rod was found to be outstanding, being readily and speedily drilled. Also it withstood the flanging operation . . . a set of manufacturing conditions where only brass, the right kind of brass, outshines all other metals and alloys.

Final score: The low first cost of the brass rod, plus its superior machinability, resulted in a more satisfactory product without the penalty of higher costs. A further advantage to the manufacturer was the added sales appeal of the brass hub.

And there you have another example of how Revere in collaboration with the manufacturer helped, "fit the metal to the job," which resulted in a better part at the least possible cost. Why don't you take advantage of this kind of service?

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drilling machines, and similar equipment. Machine tool actuators may be hydraulic, mechanical, or electrical.

Instead of tape or cards for programming, a complete set of stainless-steel keys is supplied with each system. Each key in a set is preperforated in a binary pattern by Specialties, Inc., to provide logical control of up to three operations or auxiliary functions. For a required setup, the correct keys to program the necessary sequence of operations are selected from the set and inserted in a programming drum which is mounted in the control panel. Perforation patterns in the keys are read into the system by photoelectric cells. Because there are places for thirty-six keys on the reader, a possible 108 operations of sixty-three different types are provided and may be used in any desired sequence.

With the functional sequence, programmed end points and feed rates are individually set for each required dimension by one of the dials on the control panel. For example, a turret lathe can be programmed by twelve to sixteen dials on the turret (the number of dials can be varied according to machine requirements). The turret has sixteen positioning dials available, while the cross-slide and carriage each have eight dials. In only a few minutes, the drum is programmed and rough dial settings are made. Then, with tools and work in place, a trial cut is made for each operation.

Any correction or adjustment which appears necessary after inspection of this piece can be made by dialing in the correction on the dial which controls the inpoint for that particular dimension. Usually one adjustment is sufficient unless tool-wear compensation is needed later in the run.

Circle 600 on Readers' Service Card

Clearing Press Built for Japanese Motor Company

A huge double-action press of fully enclosed design, with a height of 32 feet above the floor line, has been built by the Clearing Division of U. S. Industries, Inc., Chicago, Ill., for shipment to the Isuzu Motors Co., Ltd., Yokohama, Japan. Four Clearing single-action machines are also scheduled for immediate delivery to this Japanese company, which specializes in the production of diesel trucks and buses with capacities ranging from 2 to 6 tons. This concern also manufactures, under license, the Hillman-Minx automobile.

Giant-size press built by Clearing for a Japanese automotive manufacturer

The particular press illustrated incorporates a two-speed clutch, moving bolsters (for quick die changes), cushions with hold-down devices, hydraulic locking devices, overload protection, newest automation switch, die-space lighting, and many other extra features. Of all-welded-steel construction, the press weighs approximately 650,000 pounds. It is of the double-action, bottom drive, mechanical moving bolster, dual-speed type, and has an inner-slide capacity of 600 tons and an outer-slide capacity of 400 tons. Both the inner and outer slides have four-point suspension. The bed has an unobstructed die-space clearance of 84 inches front to back and 108 inches right to left. The bed opening is 63 inches front to back and 93 inches right to left. Inner-slide dimensions are 66 inches front to back by 90 inches right to left. The outer slide is 84 inches front to back by 108 inches right to left. Dimensions of the detachable steel bolster plate are 84 by 108 inches by 10 inches thick. Stroke of the inner slide is 38 inches and that of the outer slide, 27 inches. An adjustment of 24 inches for both inner and outer slides is provided by a motor. The power source in the customer's plant for the main and auxiliary motors is 400-volt, three-phase, 50-cycle. The main drive motor is rated at 125 hp.

Circle 601 on Readers' Service Card

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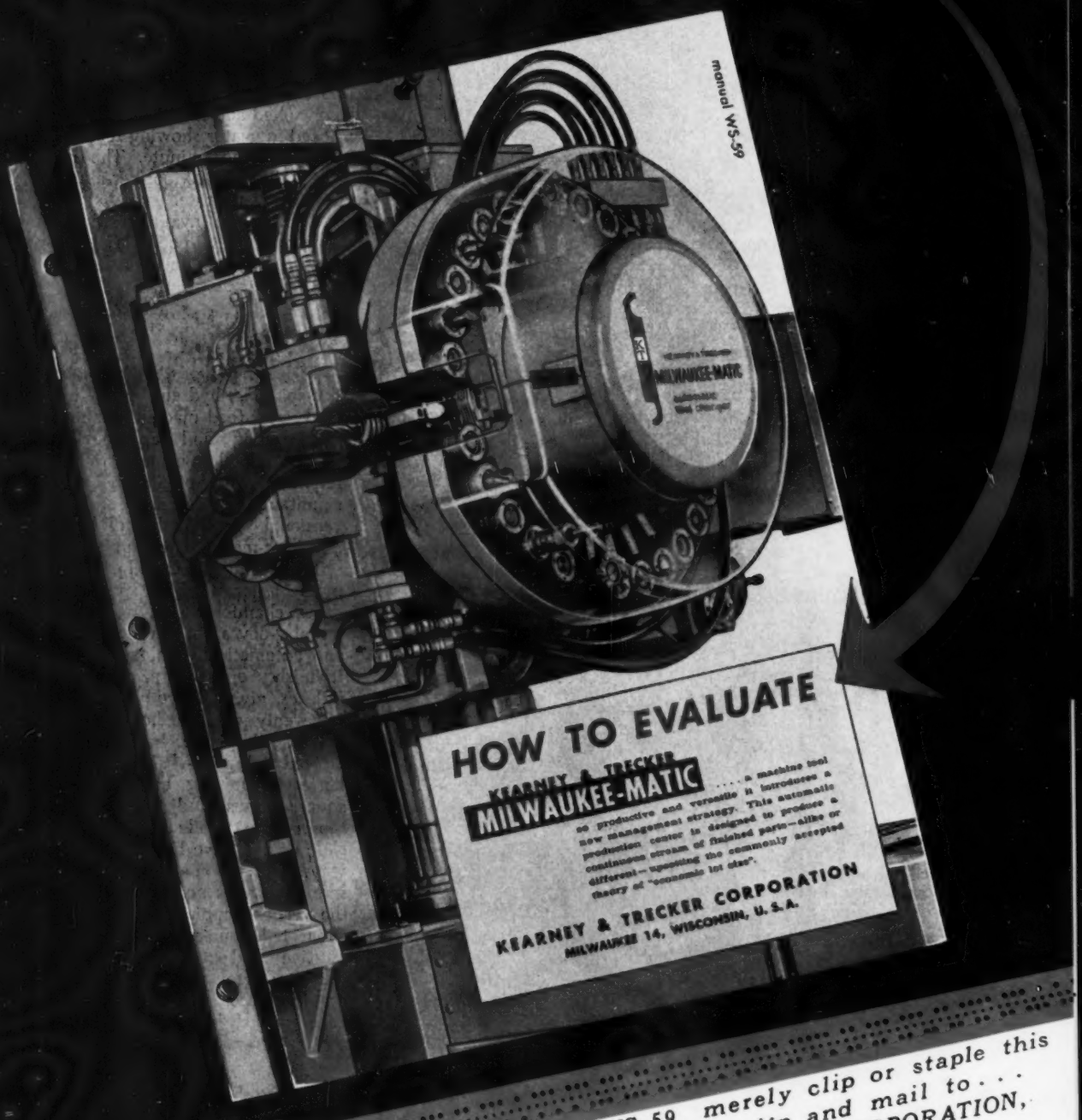

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Ty-Sa-Man gantry type, multiple-head flame cutter

Gantry Type, Multiple-Head Flame Cutter

The Ty-Sa-Man Machine Co., Knoxville, Tenn., announces the development of a new low-cost gantry type, multiple-head flame cutter that handles plate up to 20 feet wide and of any length. The new cutter, which derives its economy from lightweight fabrication as opposed to heavy cast members, uses the standard Ty-Sa-Man saw gantry. It has an unlimited capacity for squaring large plates, scarfing, beveling, and edge preparation to close precision tolerances, and can be converted for straight-line automatic welding.

The gantry unit is recommended for use with two end trimmers, which also travel on the rails with the gantry and provide cross-cut trimming by means of a movable blowpipe which travels along the transverse rail on roller bearings. The gantry ripping unit can be fitted with up to eight variable-angle blowpipes for production multiple cutting. Track travel consists of a Thy-Mo-Trol infinitely variable-speed drive through a synchronizing cross shaft and a rack-and-pinion drive to each rail. It is all push-button controlled and is equipped with a speed indicator showing feed rate in inches per minute. The machine has a 100-foot-per-minute rapid-traverse rate.

The tracks, available in any length, are 100-pound rail machined on top and sides for greater economy.

Circle 602 on Readers' Service Card

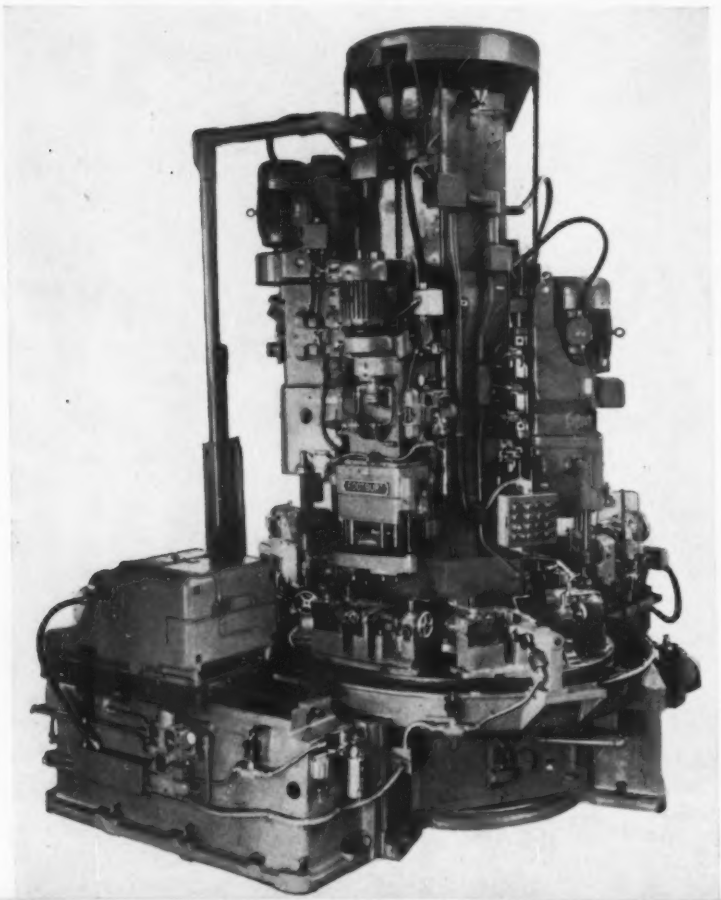
Footburt Milling, Drilling, and Tapping Machine

The Foote-Burt Co., Cleveland, Ohio, has announced a new center-column, six-station, twenty-five-spindle, hydraulic-feed and lead-screw-feed machine for milling, drilling, and tapping. The unit completely machines two different designs of oil-filter housings simultaneously, utilizing both conventional center-column heads and floor-mounted way units.

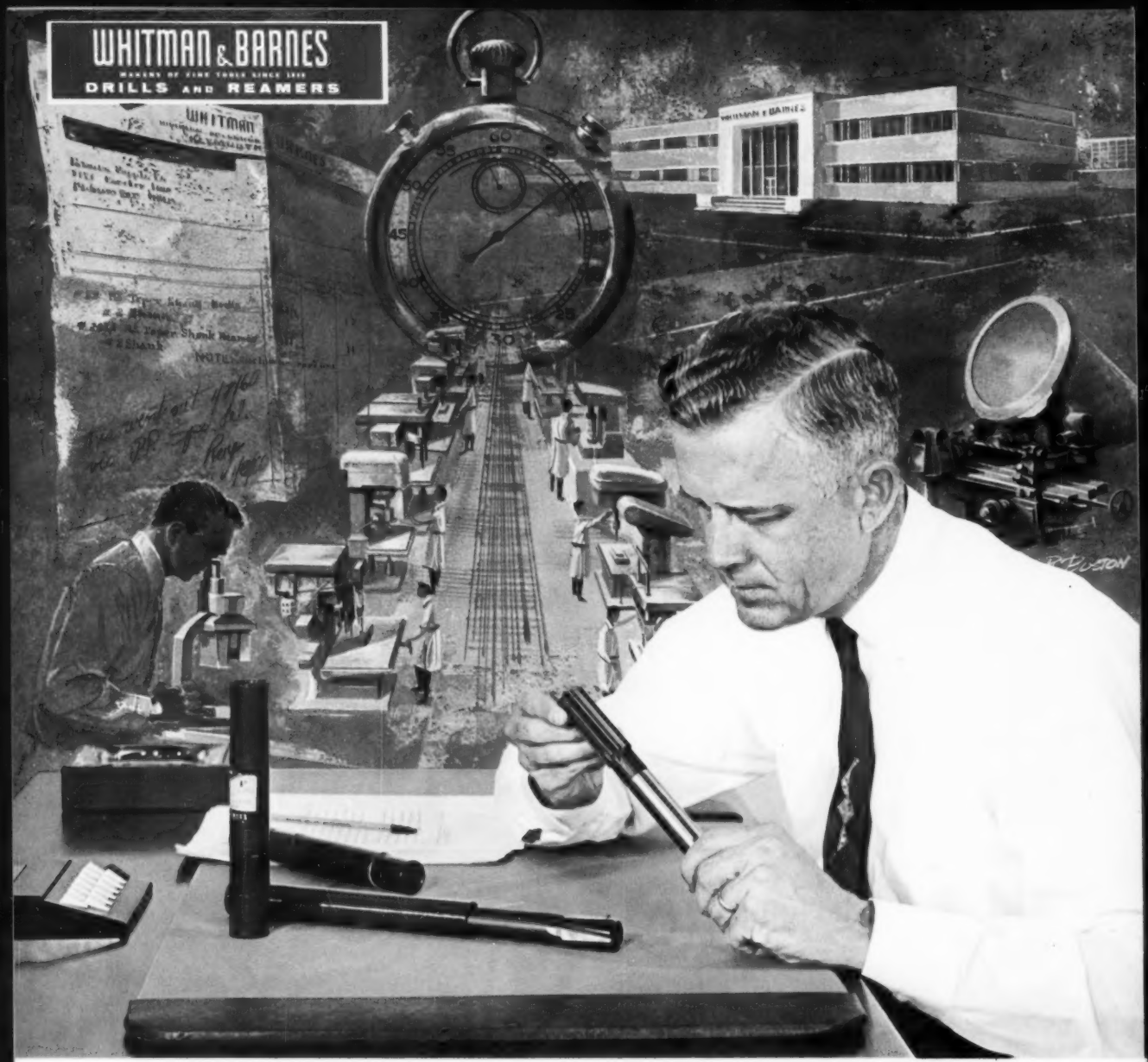
The machine loads and positions parts automatically, spot-faces, drills, chamfers, taps, reams, internal grooves, mills, rough-bores, and automatically unloads. Thus, it finishes one part each time it indexes, giving a production rate of seventy parts per hour.

All quill spindles have hydraulic feed and spline-shaft drive. The horizontal milling unit runs on square ways (adjustable with tapered gibs), while the drill heads slide on exclusive Footburt round ways. A precision adjustable lead-screw provides accurate feed for the vertical tapping head. Chain-connected counterweights assure positive feed at all times, with quick-traverse withdrawal. The cast-iron base has a separate wing base for each horizontal unit.

Merry-go-round machines of



Multiple-spindle Footburt milling, drilling, and tapping machine



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How do I know? We had a finish problem in reaming cast steel. Best finish we were getting was 150-175 micro-inch. We needed 60 or better. A W&B Service Engineer came in with one of their 1-1/16″ Chucking Reamers. He checked feeds and speeds—finally came up with .011 per revolution and 60 SFM. He recommended a secondary grind on the chamfer to assure clearance, then added a second chamfer of 67½°. We were able to get and maintain a reamed finish of 40-50 micro-inches. At the end of the day, the operator was getting all good parts and saving substantial time per piece. In a case like ours, W&B's technical help, service and consistent reamer quality really convinced me that initial price is merely one factor. Find out for yourself . . . test W&B tools in *your* plant under *your* conditions. Call them in direct or through your industrial distributor. Do it today. See if *you* can't get better results.

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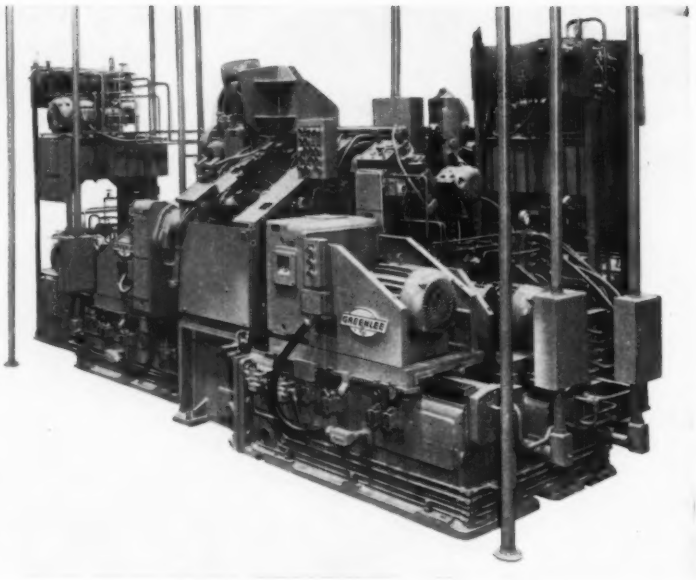
this type can be custom-fabricated with up to eight stations or more, and with almost any number of spindles. Horizontal milling, drilling, or tapping units can be built onto any station; pick-off gears for speed selection can be provided for all lead-screw units to accommodate changes in part design or production requirements.

Circle 603 on Readers' Service Card

Greenlee Indexing Machine for Processing Cast-Iron Cylinders

A four-way, four-station, horizontal automatic indexing machine recently delivered to a customer by Greenlee Bros. & Co., Rockford, Ill., processes 660 cast-iron cylinders per hour at 80 per cent efficiency. Four pieces are power-clamped in the first station and moved through the four stations in 17.4 seconds. The machine has two hydraulic control centers.

The work is loaded and unloaded at the first station. At the second station, tools in the left-hand head combination face the end and chamfer the inside diameter of the part, while tools in the right-hand head combination core-drill and hollow-mill the outside diameter, and face-chamfer the inside diameter. Semifinishing, through boring, and hollow milling are performed by tools in the left-hand head, while combination recess cutting and radius forming is done by tools in the right-hand head in the third station. At the fourth station, combination recess cutting and radius forming is done by tools in the left-hand head, while tooling in the right-hand head mills a groove in the bore of the cylinder.



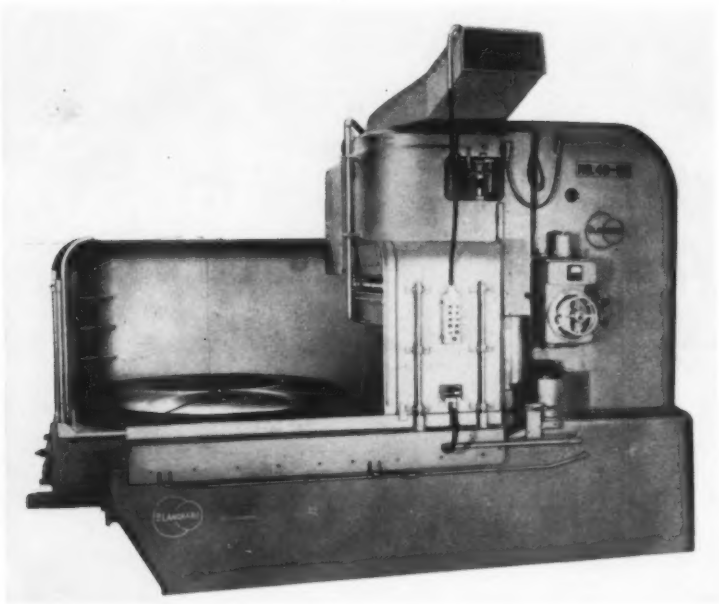
Automatic indexing machine equipped to process cast-iron cylinders brought out by Greenlee Bros. & Co.

Circle 604 on Readers' Service Card

Blanchard King-Size Surface Grinder

The Blanchard Machine Co., Cambridge, Mass., has announced the design and development of what is said to be the largest vertical-spindle surface grinder available. This new No. 48-96 machine has a 96-inch diameter, full magnetic chuck, and will swing and grind to the center of work up to 108 inches in diameter. The chuck will hold a maximum work load of 10,000 pounds.

Work up to 40 inches in height can be accommodated under a new 48-inch diameter Cortland type segment wheel. The chuck completely clears the wheel when in the loading position. Base ways and guide strips for the chuck table are hardened to assure long, accurate life. Regularly supplied with a 100-hp spindle motor, the new grinder is also available with motors up to 150 hp.



Vertical-spindle surface grinder equipped with 96-inch diameter chuck announced by the Blanchard Machine Co.

Circle 605 on Readers' Service Card

(*This section continued on page 196*)

this power plant packs a Sunday Punch ...EVERY DAY IN THE YEAR!

This husky self-contained power unit combines true economy with tremendous efficiency to power cylinders, chucks, clamping devices and many other hydraulic machines.

Teamed up with Logan's "Super-matic" cylinder, this unit can generate thousands of pounds of pressure and maintain a steady, trouble-free operation month after month—at top production speeds. If you would like additional information about this compact power unit, or any of Logan's other products, just fill in and mail the coupon below.

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COMPANY.....

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NEW CATALOGUES

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Presses

Minster Machine Co. Minster, Ohio. Bulletin 15 covering the company's line of open-back inclinable presses, in 16- through 75-ton capacities. Press and slide construction, inclining mechanisms, and lubrication arrangements are detailed.

Circle **Item 501** on Inquiry Card

Numerically Controlled Machine

Kearney & Trecker Corporation, Milwaukee, Wis. Bulletin No. MM-3 presenting the company's Milwaukee-Matic Model III numerically controlled machine, which unifies face milling, end milling, drilling, reaming, tapping, boring, counterboring, etc.

Circle **Item 502** on Inquiry Card

Industrial Power Tools

Rockwell Mfg. Co., Delta Power Tool Division, Pittsburgh, Pa. Revised catalogue presenting a complete line of industrial power tools and accessories. Included are drill presses, grinders, shapers, planers, jointers, metal-cutting lathes, etc.

Circle **Item 503** on Inquiry Card

Iron Sizes and Shapes

Greenlee Foundry Co., Chicago, Ill. Handbook containing data on the company's standard sizes and shapes made from Class A Meehanite, an engineered gray iron. Included are round solid bars, round cored bars, square and rectangular bars, etc.

Circle **Item 504** on Inquiry Card

Cleaning Equipment

National Ultrasonic Corporation, Irvington, N. J. Catalogue No. 60 covering ultrasonic cleaning equipment, such as Heavydutyline, Standardline, and high-power generators; tanks; immersible transducers; roll-around units; and console cleaners.

Circle **Item 505** on Inquiry Card

Clarifier

Gale Separator Co., division of Infilco, Inc., Tucson, Ariz. Bulletin 9050 giving information on the Sediflotor clarifier for grinding coolants and other industrial liquids. Included are diagrams, design factors, and special features.

Circle **Item 506** on Inquiry Card

Optical Comparator

Jones & Lamson Machine Co., Springfield, Vt. Brochure on the J&L Model FC-30 optical comparator and measuring machine. Featured are descriptions of the Telecentric optical system, table styles, reflection attachment, and tracing units.

Circle **Item 507** on Inquiry Card

Electrical Contacts

Engelhard Industries, Inc., Newark, N. J. Bulletin (Vol. 1, No. 2) presenting a study of precious-metal electrical contacts. Included are articles on thermocouple materials and problems posed by radioactivity in the refining of precious-metal scrap.

Circle **Item 508** on Inquiry Card

Lathes

Bardons & Oliver, Inc., Cleveland, Ohio. Brochure describing the company's line of machine tools, including five ram and saddle type turret lathes, with collet capacities of 1 to 5 inches, and cutting-off lathes in ten different sizes.

Circle **Item 509** on Inquiry Card

Swiss Automatics

American Bechler Corporation, Stamford, Conn. Bulletin AR-60 containing data on Bechler Model AR Swiss automatic bar machines and accessories. Featured are the three-spindle universal attachment and six-spindle hydraulic drum turret.

Circle **Item 510** on Inquiry Card

Overhead Materials Handling

Cleveland Tramrail Division, Cleveland Crane & Engineering Co., Wickliffe, Ohio. Booklet No. 2008-Q giving data on overhead materials handling. Carriers, cranes, tractors, track switches, grabs, and electrification are described and illustrated.

Circle **Item 511** on Inquiry Card

Numerical Control

General Electric Co., Schenectady, N. Y. Bulletin GEA-7209 on the Mark Century transistorized machine tool control, which performs positioning and/or contouring from standard punched-tape program. Computerless contouring is summarized.

Circle **Item 512** on Inquiry Card

R B&W FASTENER BRIEFS

RUSSELL, BURDSALL & WARD BOLT AND NUT COMPANY

Technical-ities

By Fred E. Graves

Fastening of "vibration" joints

With static assemblies, your only fastening worry is enough safe load capacity. But with dynamic loading, you also have to guard against loosening.

HIGH THREAD TENSION

You'll find one of the best locking mechanisms within the fastener itself: high thread tension. Obviously, the tighter the fastener, the higher the tension and the better the "lock."

CASE HISTORIES

(1) Textile looms notoriously suffer from vibration. Yet their bolts stay tight *without any locking device* when highly preloaded. (2) Heavy duty shakers had joint loosening problem which was solved for good when the maker switched to *high strength hex bolts torqued up almost to yield strength.*

Using split lock washers gives no such guarantee against loosening. It becomes equivalent to a solid washer at a relatively low load level. Once the screw has loosened to the point where the washer becomes a spring, it's too loose for safety.

When you can't fully utilize a high strength fastener, go to a bolt with prevailing torque lock nut; or to a unit that combines high thread tension along with a high off-torque value (such as RB&W's TENSILOCK fasteners—see Bulletin TL-2.)

With vibration joints involving thin gauge or sheet metal, it's better to use a *thread-cutting* screw, than a machine screw in tapped hole. It gives 100% depth of thread contact for more thread friction to resist backoff.

Some ideas for savings through cold forming

It generally costs less to cold-form a part than to machine it, since there's less scrap loss and more speed. The cold working strengthens the part, too—improves its physicals.

These four cases show what happened when designers and production men referred their needs in special parts to RB&W.

1. **Ball-head stud.** Formerly produced on screw machine, this truck mirror pivot suffered high scrap loss, cost 75% more than it did when RB&W produced it by cold forming and some secondary machining.

2. **Spacer.** Cost of this automobile trunk hinge spacer was cut 50% when RB&W cold-formers took on the job of pounding them out at high speed, finely finished and ready for installation.

3. **Taper plug.** Time and money were both saved by manufacturer of expansion bolts who came to RB&W to make these parts. Cold headers formed them faster than screw machines, and with zero scrap.

4. **Adjustment cam.** Cold forming affords the *only* economically feasible way to produce this part. Due to its large eccentric and hex end, machining and material costs would be excessive.

These examples typify a range of work from RB&W cold heading and cold forming facilities. RB&W also performs many secondary operations on parts to specification, such as drilling, slotting, knurling, etc. Best way to see whether you have a part that could cost you less is to refer it to RB&W for study. Write Russell, Burdsall & Ward Bolt and Nut Co., Port Chester, New York.

Plants at: Port Chester, N. Y.; Coraopolis, Pa.; Rock Falls, Ill.; Los Angeles, Calif. Additional sales offices at: Ardmore (Phila.), Pa., Pittsburgh; Detroit; Chicago; Dallas; San Francisco.

For more data circle this page number on card at back of book

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Drilling and Tapping Machine

Burgmaster Corporation, Gardena, Calif. Bulletin discussing the features of the Burgmaster bench-model automatic six-spindle turret drilling and tapping machine, which is equipped with power feed and rapid manual positioning table.

Circle **Item 513** on Inquiry Card

Groov-Pins and Drive Studs

Groov-Pin Corporation, Ridgefield, N. J. Bulletin featuring the types, dimensions, and fastening applications of solid Groov-Pins and grooved drive studs. Described are materials used, drilled hole tolerances, shear strength, maximum torque, etc.

Circle **Item 514** on Inquiry Card

Blast-Cleaning Equipment

Pangborn Corporation, Hagerstown, Md. Bulletin No. 227A telling how the company's Rotoblast impeller uses controlled centrifugal force for its blast-cleaning power. Described are modifications developed to increase production speed.

Circle **Item 515** on Inquiry Card

Cam Contouring Machine

Olofsson Corporation, Lansing, Mich. Bulletin presenting information on the company's Model 41 air-operated cam-controlled machine for production boring, turning, contouring, and facing operations. Specifications and design features are included.

Circle **Item 516** on Inquiry Card

Antiscoring Lubricant

Chicago Mfg. & Distributing Co., Chicago, Ill. Brochure on the company's CMD antiscoring lubricant, for use in lathe centers; steadyrests; thrust bearings; die-set posts; cams; machine ways; broaching, extruding, and swaging operations, etc.

Circle **Item 517** on Inquiry Card

Blanking Process

Hydro-Cam Engineering Co., Troy, Mich. Catalogue on the Hydro-Cam Smooth-Edge blanking process that produces precision-stamped low-carbon steel, stainless-steel, aluminum, brass, and copper blanks with straight, smooth edges in one operation.

Circle **Item 518** on Inquiry Card

Indexing Tables

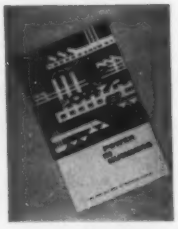
AA Gage Co., Detroit, Mich. Catalogue U-100 presenting specifications on high-precision Ultradex indexing tables. For use on machine tools, inspection setups, or combinations of the two, these tables will index to 1/4 second of arc.

Circle **Item 519** on Inquiry Card

Adjustable-Speed Drives

General Electric Co., Schenectady, N. Y. Bulletin GEA-7208 describing Statotrol drives—half-wave, fractional-horsepower, electronic adjustable-speed drives employing silicon-controlled rectifiers instead of tubes to supply power to the motor.

Circle **Item 520** on Inquiry Card



Numerical Control

Norden Division of United Aircraft Corporation, Costa Mesa, Calif. Booklet, entitled "Power in Numbers," explaining how numerical control works, and telling what it can do and why it is such an important development. Diagrams are included.

Circle **Item 521** on Inquiry Card

Rotary Screw Type Pump

De Laval Steam Turbine Co., Trenton, N. J. Bulletin 3200 giving details on the De Laval IMO rotary screw type pumps for petroleum and process industries; power hydraulics; fuel, lubricating oil, and seal oil applications; and fire-resistant fluids.

Circle **Item 522** on Inquiry Card

Wheel Dresser

Tracaform Corporation, Warren, Mich. Brochure covering the Tracaform Model SMD-704 spindle-mounted contour wheel dresser. It is a 1-to-1 ratio template- tracing wheel dresser, designed to fit surface grinders using a 7-inch diameter wheel or less.

Circle **Item 523** on Inquiry Card

Measuring Instruments

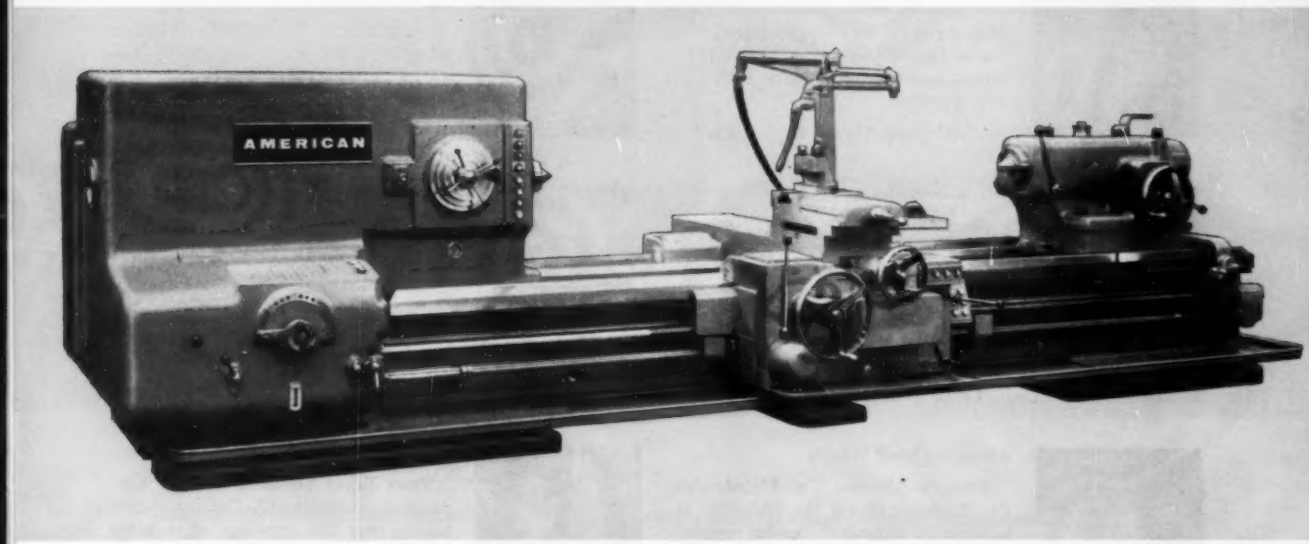
Niagara Machine & Tool Works, Buffalo, N. Y. Product report (No. 2) providing information on two electronic precision instruments, the Niagara Load Monitor and Tonmeter, designed to safeguard dies and presses during production runs.

Circle **Item 524** on Inquiry Card

TALK ABOUT ABILITY!

This husky boasts a 100 hp main drive motor and spindle speed range of 6 to 750 rpm. Its massive 7½" tailstock spindle offers big load capacity. Pre-selective hydraulic powershift and push button control of cross and longitudinal feeds keep this giant under fingertip control. 48 spindle speeds provide any surface speed with a deviation of less than 6% from that actually required for the chosen diameter. The operator, after setting the correct surface speed, merely dials the work diameter. The computing dials then automatically produce the correct rpm for each diameter. Or . . . the operator may choose rpm directly if he wishes. Write for Bulletin 913-A.

100 HORSEPOWER AMERICAN 40" STYLE J-100 PRE-SELECT ENGINE LATHE



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Optical Comparator

Micro-Vu, Inc., North Hollywood, Calif. Brochure describing the Micro-Vu optical comparator. Featured are a ground and lapped cast-iron table; 6-volt transformer system; fiber-glass molded case; and 20× achromatic, color corrected lens.

Circle **Item 525** on Inquiry Card

Die Sets

Wheatley Economy Die Sets, Inc., Detroit, Mich. Brochure giving sizes and other technical data on various sizes of Wheatley's all-steel "economy" die sets, available in handy kit form. A price list with quantity discounts is also included.

Circle **Item 531** on Inquiry Card

Welding Torches

Linde Company, division of Union Carbide Corporation, New York City. Brochure (Form 55-005) featuring details on the Oxweld W-45 and W-47 welding torches, which are capable of welding any metal thickness from 28-gage sheet to heavy plate.

Circle **Item 526** on Inquiry Card

Numerically Controlled Machine

Hughes Aircraft Co., Los Angeles, Calif. Catalogue describing the Hughes MT-3 machining center, a numerically controlled machine tool for milling, drilling, boring, tapping, and reaming operations. Featured are typical parts produced.

Circle **Item 532** on Inquiry Card

Steel

Republic Steel Corporation, Cleveland, Ohio. Catalogue covering Republic's stainless steels; titanium; electrical, high-strength, and vacuum-arc-melted steels. Cold-drawn special sections, fasteners, and Electro Paintlok steel sheet are described.

Circle **Item 527** on Inquiry Card

Ball-Bearing Screws and Splines

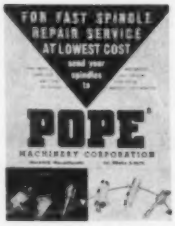
Saginaw Steering Gear Division, General Motors Corporation, Saginaw, Mich. Engineering data book providing basic principles, types, and applications of ball-bearing screws and splines. Featured are design data and sample problems.

Circle **Item 533** on Inquiry Card

Die Accessories

Producto Machine Co., Bridgeport, Conn. Catalogue containing data on a broadened line of die springs and accessories. Square- and oval-wire carbon-steel die springs, chrome-vanadium oval-wire die springs, music wire springs, etc., are featured.

Circle **Item 528** on Inquiry Card



Spindle Repair

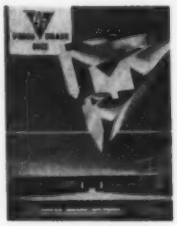
Pope Machinery Corporation, Haverhill, Mass. Bulletin R-4 covering the company's facilities for fast repair or rebuilding of all makes of spindles. Methods and equipment for assembly, dynamic balancing, and electronic testing are described.

Circle **Item 534** on Inquiry Card

Abrasive Cutoff Wheels

Simonds Abrasive Co., Philadelphia, Pa. Catalogue (Form No. ESA-163) describing the company's regular resinoid-bonded abrasive cutoff wheels. Presented are details on production cutting use, as well as general use in toolrooms and machine shops.

Circle **Item 529** on Inquiry Card



Press-Brake Dies

Press Brake Division, Valeron Corporation, Addison, Ill. Catalogue containing over 360 drawings of standard and special press-brake dies. Included are tonnage requirement tables for punching and bending various thicknesses of mild sheet steel.

Circle **Item 535** on Inquiry Card

Thread- and Gear-Measuring Wires

Van Keuren Co., Watertown, Mass. Buyers catalogue and price list (36B, Section W) giving a description of the company's thread- and gear-measuring wires. Sizes from 0.0015 to 2.000 inch in diameter can be furnished. Specifications are given.

Circle **Item 530** on Inquiry Card

Bearings

Kaydon Engineering Corporation, Muskegon, Mich. Bulletin S-109 giving a description of the company's Type "CP" off-the-shelf Reali-Slim Conrad ball radial bearings, available in ninety sizes. Special Reali-Slim bearings are also described.

Circle **Item 536** on Inquiry Card

SOLD THROUGH INDUSTRIAL DISTRIBUTORS

Cushman Air Operated Chucking Equipment reduces chucking and unchucking time from minutes to seconds and increases machining output accordingly. Cushman Air Operated Chucking Equipment provides instant, positive work piece gripping . . . any tendency towards slippage causes air pressure follow-up to exert more jaw pressure. With full control of jaw pressure for the material being machined, Cushman Air Chucking virtually eliminates operator fatigue and related rejects as well as decreasing floor-to-floor time and improving machining accuracy and efficiency.

Write now for Bulletin No. PO-66D and see how Cushman Air Chucking Equipment installed on either new or old equipment can save you time and money at an investment which will quickly pay for itself.

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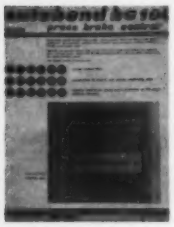


Press-Brake Control

General Automation Corporation, Flushing, N. Y. Brochure covering the company's Autobend BC-100 press-brake control for automatic whipless and uniform bending; easy handling of troublesome pieces; and two-operator control of any operation.

Circle **Item 537** on Inquiry Card

Automatic Gages

Federal Products Corporation, Providence, R. I. Catalogue 60 AM on a line of automatic gages and gaging components featuring transistor-operated gaging and control equipment. Mounting dimensions and specifications are given in a supplement.

Circle **Item 543** on Inquiry Card

Torque-Locking Device

Formsprag Co., Warren, Mich. Catalogue RL-101 describing the Rev-Lok dual torque-locking and positioning device, a two-directional drive unit which can be mounted to transmit driving torque efficiently, overrun, prevent feedback, etc.

Circle **Item 538** on Inquiry Card

Drilling Machine

Giddings & Lewis Machine Tool Co., Fond du Lac, Wis. Bulletin No. BR-11 covering a Bickford 11-inch radial drilling machine with adjustable hydraulic-spindle counterbalancing, magnetic drive clutch, and automatic tapping reverse.

Circle **Item 544** on Inquiry Card

Roll Feed

Benchmaster Mfg. Co., Gardena, Calif. Catalogue giving details on the company's redesigned automatic precision roll feed. Features include a new roller cam clutch, improved accuracy, large lower rollers, and stronger spring load.

Circle **Item 539** on Inquiry Card

Lathe

Cincinnati Lathe & Tool Co., Cincinnati, Ohio. Catalogue N-250 on the Cintimatic numerically controlled lathe. Taped commands, read through the Acramatic control console, provide automatic control of all machining and operating functions.

Circle **Item 545** on Inquiry Card

Flame-Cutting Machines

Linde Company, division of Union Carbide Corporation, New York City. Catalogue (Form 1396) covering a complete line of Oxweld flame-cutting machines ranging in size from small portable models to huge multiple-torch shape-cutting machines.

Circle **Item 540** on Inquiry Card

Optics in Gaging and Tooling

Engis Equipment Co., Chicago, Ill. Metrology paper, by E. J. Schneider, featuring a discussion of many of the essentials of optics application, optical engineering tools, interferometry, and principles and applications of optical instrumentation.

Circle **Item 546** on Inquiry Card

Nondestructive Testing

Sperry Products Co., division of Howe Sound Co., Danbury, Conn. Bulletin 00-105 providing data on the Sperry line of ultrasonic testing equipment, portable industrial X-ray units, and magnetic-particle inspection equipment and supplies.

Circle **Item 541** on Inquiry Card

Hard-Gear Finishers

Michigan Tool Co., Detroit, Mich. Bulletin No. 999-60 containing a description of the improved Michigan Model 999 abrasive hard-gear finishers. How they are used for final surface conditioning of gear teeth after hardening is illustrated.

Circle **Item 547** on Inquiry Card

Point Wheels

American Emery Wheel Works, Providence, R. I. Bulletin SS-101 giving details on special-shape mounted point wheels. Specifications on wheels available; wheel shapes, diameters, and lengths; mandrel diameters; and list prices are given.

Circle **Item 542** on Inquiry Card

Drill Presses

Walker-Turner Division, Rockwell Mfg. Co., Pittsburgh, Pa. Brochure describing the new line of Walker-Turner light-heavyweight 17-inch drill press equipment. Included are specification data, charts, and tables on all features of the line.

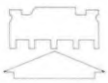
Circle **Item 548** on Inquiry Card

When you think of PRECISION

For life time precision Lucas provides

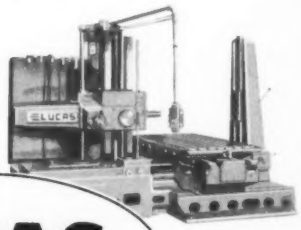
airlift to saddle

and table.



These elements are supported on a thin film of lubricated compressed air during traverse. This separation of metal from metal virtually eliminates wear. During machining cycles the saddle and table are automatically clamped down tight to provide absolute rigidity for even the heaviest cuts. Unclamping is automatic, too. These are two aspects of Lucas design which contribute to the precision of these machines. Lucas Machine Division, The New Britain Machine Company, 12302 Kirby Avenue, Cleveland, Ohio. When you think of Precision . . .

think of . . .



LUCAS
PRECISION

When you think of RELIABILITY

Lucas automatic power positioning

automatically repeats

automatically repeats

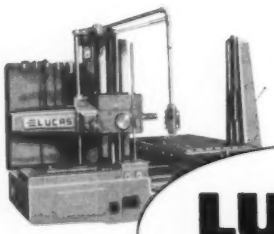
automatically repeats

to ±.0001 . . .

A simple, completely reliable system of dial indicators, end measures, and electrical controls automatically disengages rapid traverse, engages the fixed, constant-rate power feed and precision stops the unit at predetermined settings. Automatic power positioning assures the highest order of repetitive accuracy with an absolute minimum of operator attention.

A new catalog describes our complete line of horizontal boring, drilling and milling machines. Write Lucas Machine Division, The New Britain Machine Company, 12302 Kirby Avenue, Cleveland, Ohio. When you think of Reliability . . .

think of . . .



LUCAS
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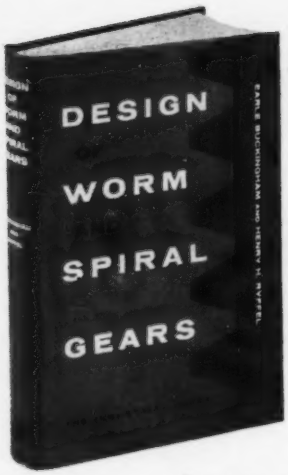

New!

DESIGN OF WORM AND SPIRAL GEARS

by Earle Buckingham, *Professor Emeritus, Massachusetts Institute of Technology; Gear Consultant*
and
Henry H. Ryffel, *Gear Consultant, Superior Manufacturing & Instrument Corp.; Associate Editor, MACHINERY's HANDBOOK*

Answers Questions Like These

HOW DO YOU . . .

- design fine-pitch worms for indexing?
- design worm and spur gear drives?
- design spiral and worm drives with shafts at less than 90 degrees?
- design critical worm gear drives?
- calculate acceleration and dynamic loads?
- determine radiation of heat and oil cooling?
- determine mechanical efficiency of spiral and worm drives?
- replace spiral gears with a worm drive?
- use diametral pitch worms for high speed and small reduction ratios?
- design housings?
- mount worms and worm gears?
- design built-up worm gear blanks?
- use small screw threads as worms?

WHAT IS KNOWN ABOUT . . .

- the effect of all-recess action on coefficient of friction?
- the use of torsion bars to reduce dynamic loads?
- lubrication, friction, and wear?
- influence of position of pitch plane on contact between worm and gear?
- the misuse of the hunting tooth?
- relation of pitch surface forms to axes of gears?
- influence of misalignment on the forms of pitch surfaces?

WHAT IS THE NATURE OF . . .

- contact conditions of spiral gears?
- contact on enveloping worms?
- conjugate gear tooth action on worm drives?
- load distribution across the face of worm gears?
- limits of conjugate gear tooth action?
- axial thread forms produced by different methods of cutting?
- effect of pressure angle on contact of worm gears?
- effect of lead angle on contact worm gears?
- effect of diameter on contact of worm gears?

WHAT PROCEDURES ARE USED TO . . .

- design a complete spiral gear drive?
- design a complete worm gear drive?
- make an analysis of bearing loads for spiral and worm gear drives?
- make a graphical contact analysis?
- make an analytical contact analysis?
- determine the line of zero pressure angle?
- design for specified center distances?
- develop a practical series of speed-reducing worm drives?
- design step-up drives?
- design spiral gears by geometric similarity?
- determine center distances for all-recess action?

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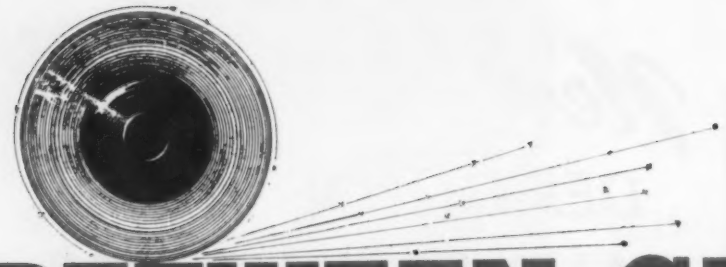
M2/61



By E. S. Salichs

BETWEEN GRINDS

Rum in Davy Jones's Locker

The RUM (Remote Underwater Manipulator) vehicle—not a portable bar as you might suppose—was developed for the Office of Naval Research, according to *Industrial Research Newsletter*, by the Scripps Institution of Oceanography Marine Physical Laboratory (which needs initials, too). The device is equipped with a mechanical arm and electronic eyes, and carries cable for the transmission of instructions and information to and from shore-based control stations.

Bendix Brainstorm

The Bendix G-15 computer, speaking a numeric language, has produced a 511-page book entitled "Angular Indexing Tables." Admittedly, the computer had some human help—from Jacob J. Jaeger, president of Pratt & Whitney Co., Inc., and his director of development engineering, Edward E. Kirkham.

The Sign of Steel

Materials nowadays often not looking like what they are, the steel industry has adopted the Steelmark, a symbol which will appear on retail goods to assure the customer that the article he is buying is fashioned of steel. The symbol is a circle that encompasses three four-pointed star-like figures called hypocycloids. Take one point away from an ordinary star, and you have a case on your hands.

RAMAC and the Rod

Used at the Sebring International Auto Race in Florida was the IBM RAMAC 305 data-processing system. Producing answers for the "Index of Performance" faster than the cars burnt up miles, the system made it possible for drivers and spectators to know the official standing of each of the sixty-five cars while the twelve-hour race was in progress.

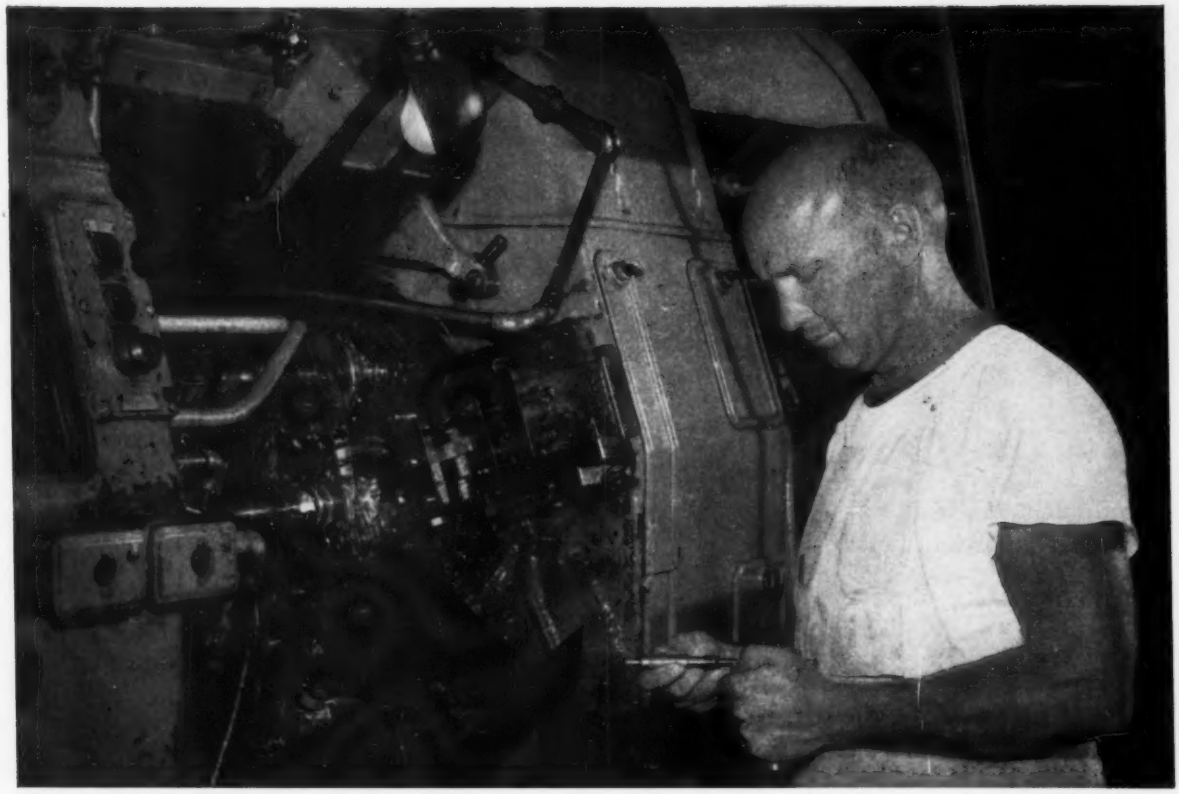
Cozy Quarters

A furniture designer has come up with a sectional cabinet that contains a sofa bed, four-drawer chest, storage space, hi-fi unit, record player, radio control panel, and electric clock. Or surround the snorer with sound.

You Too Can Be a Fogman

Have you ever planted seeds in your garden, then washed them away with the hose? There is now a nozzle to be attached to the hose, creating a soft blanket of fog.

REWARDED AND RELATED—When mother and son simultaneously receive awards for twenty-five years of service with a company, this is news. And so felt Norton board chairman George N. Jeppson (right) as he presented watches and certificates to Mrs. Agnes S. Ekholm (who went to work in the Norton office after the death of her husband, a company employe) and her son, Norman R. Ekholm (left), who is now Atlanta district manager.



Manufacturer increases tool life 20% with CLEARTEX

—saves $100 monthly on oil alone!

The Master Vibrator Company of Dayton, Ohio—maker of portable heaters, cement finishers and other contractor equipment—was having trouble with lube oil diluting the cutting oil on their automatic screw machines. There were too many tool regrinds and too many rejects. A Texaco Metalworking Engineer suggested a test of Cleartex. They agreed to using a 10 gallon sample on one automatic. That was November, 1959.

In one month they were convinced. By using Cleartex on both cutting and lube sides they solved their problem —no more dilution of cutting oil. And look at the results: Tool life increased 20%; actual monthly savings on oil of $100; less carry-off on chips; cleaner machines; fewer rejects; happier operators and delighted management! No wonder they switched entirely to Cleartex and are now regular users of 10 drums a month!

Why not send for your copy of Texaco's new booklet —"Cleartex in Automatic Screw Machines." This illustrated guide will show you how to end dilution of cutting oil—and the profit-draining costs in rejects and tool life it causes. Just mail the coupon. Or if you want immediate savings, ask to have a Texaco Metalworking Engineer set up a test in your plant—on one machine, or on your whole line.

Texaco Inc., 135 East 42nd Street, New York 17, N.Y.

Tune In: Texaco Huntley-Brinkley Report, Mon. Through Fri.-NBC-TV

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Hughes welder for joining ultrathin wires

Drilling hardened steel with new DoALL drill

Equipment for Welding Ultrathin Wires and Foils

The vacuum-tube products division of the Hughes Aircraft Co., Culver City, Calif., has announced the development of a 10-watt-second, stored-energy precision welder designed especially for welding ultrathin wires and foils. Designated the VTW-28, it delivers power in a range that is adjustable from 0.01 to 10 watt-seconds in less than 0.001 second.

A variable transformer and silicon rectification eliminate the need for tubes in the charging circuit and assure a smooth, stable output. The small, compact VTW-28 may be used in resistance welding of the finest wire and materials produced. With a miniature welding head or tweezers, wires as small as 0.0002 inch can be cross-wire welded with only a minimum of operator skill.

Circle 606 on Readers' Service Card

DoALL Drill for Hardened Steel

The DoAll Co., Des Plaines, Ill., has introduced a new drill for hardened steel that is not carbide yet is capable of drilling steel having a hardness greater than 51 Rockwell C. This drill can easily be resharpened or modified with an aluminum-oxide wheel. It anneals the material at the drill-point area as heavy pressure is applied and generates intense heat from the pressure exerted, permitting the removal of a softened chip. The drill itself has a remarkably high red-heat hardness and is not affected by intense heat except for a slight rounding over of the point, which actually helps the heat generation. The heat generation is local and is confined to a small area adjacent to the hole. As an example, after drilling a 3/8-inch-diameter hole in a file 1/4-inch thick, the original Rockwell 64 C hardness was only reduced to 61 Rockwell C, 1/16 inch from the hole.

These new drills for hardened steel are not recommended for use on materials that are naturally hard and cannot be annealed. They can be used successfully on manganese steels and similar work-hardening metals. With a minimum of 0.004 inch of stock to be removed, the drills will operate like a reamer on hardened steel. They are available in a size range of from 1/8 through 3/4 inch and are also made up in a set which includes sizes 3/16 through 1/2 inch by 16ths.

Circle 607 on Readers' Service Card

(*This section continued on page 198*)

THERE HAS ALWAYS BEEN
One Outstanding Name
IN FRESH OIL LUBRICATION...
MADISON-KIPP

Fresh Oil Lubrication is automatic, closely measured, constantly fed new oil under pressure for each friction surface to which it is applied.

Machine Tools, Compressors and special machines of all kinds have been kept in top condition for 20 or 30 years or more when equipped with one of 6 models of Madison-Kipp Lubricators.

The Model OL—one of the 6 Models of Madison-Kipp Lubricators.

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203 WAUBESA STREET • MADISON 10, WIS., U.S.A.
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Designed To Do *More* Jobs . . . Produce *More* Work . . . Save *More* Production Time and Cost

Proved, definitely, as the cutting tool for the die-sinking industry, T-J now offers an expanded cutter line for the precision milling of today's high speed, high production manufacturing. The new line has been designed to do more, as well as add to individual cutter life. Cutters feature a high helix angle, double back-off, right or left hand spiral, and flats on the shanks for set screw type chucks. Write today for Catalog No. 259 and complete details to The Tomkins-Johnson Co., 2425 W. Michigan Ave., Jackson, Mich.

Representation in all major areas, including Canada.

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RIVITORS...AIR AND HYDRAULIC CYLINDERS...CUTTERS...CLINCHORS

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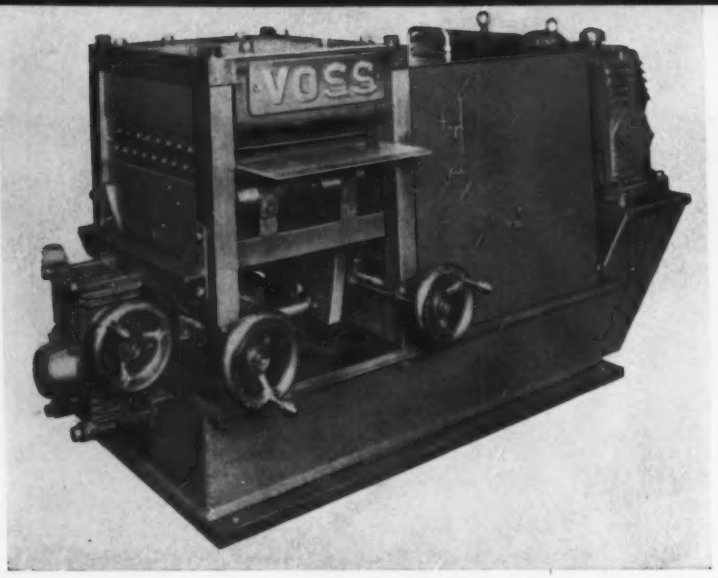


Fig. 1. Automatic flattener for stamped parts made by Voss Engineering Co.

Fig. 2. Typical parts flattened in one pass through Voss machine shown in Fig. 1

Flattener for Small Parts Eliminates Hand Straightening

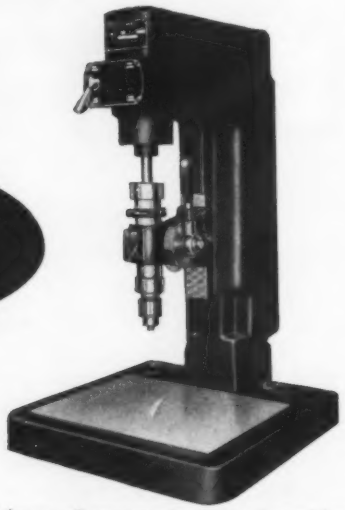
A machine that straightens stamped parts rapidly and automatically, eliminating the necessity for hand straightening operations, has been developed by the Voss Engineering Co., Pittsburgh, Pa. This machine, Fig. 1, is said to consistently maintain finished dimensions within 0.002 to 0.003 inch of dead flatness.

The operation of the new parts flattener is based on a series of small-diameter work rolls supported by multiple backup bearings. The parts are worked to relieve stresses, thus obtaining almost dead flatness in one pass. Parts of the type shown in Fig. 2 can be fed into the machine by hand or automatically, thus increasing production hundreds of times over present hand methods. The machine will handle a wide variety of flat stamped parts. In some instances it can be especially engineered to flatten parts having irregular surfaces. Most models are compact enough to sit on a desk top. The machine shown in Fig. 1 is 47 5/8 inches deep, 57 1/8 inches long, and 28 5/8 inches high.

Circle 608 on Readers' Service Card

production drill
for precision holes

Avey



Let us show you how to knock hours off your production and precision drilling with this MA-8. Capacity to ⅜". Eight spindle speeds with 10:1 range (variable speeds optional). Hand feed or air hydraulic. 12" swing. Column or bench type. One to six of our famous precision spindles, which give you quiet, vibrationless speeds up to 12,000 rpm. Send for Bulletin 857 or phone us. Avey, Box 1264, Cincinnati 1, Ohio.

Span and Zero Recorders

The Barber-Colman Co., Wheelco Industrial Instruments Division, Rockford, Ill., has announced two new recorders. The three-dial instrument shown in Fig. 1 is a greatly improved ad-

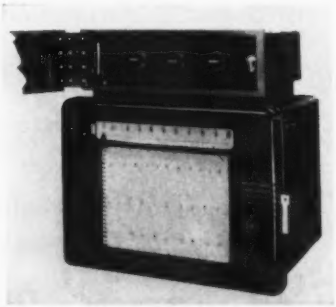
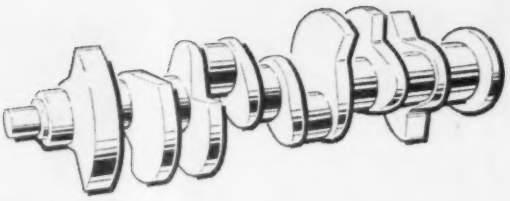
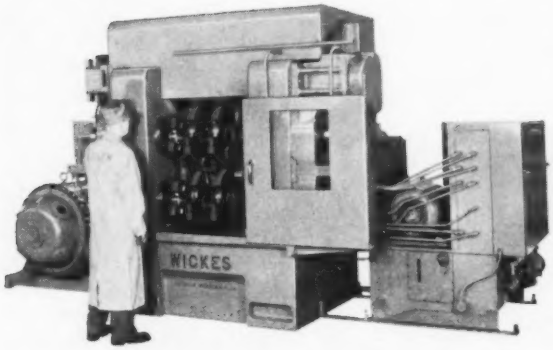


Fig. 1. Wheelco three-dial span and zero recorder



WEIGHT WHERE IT COUNTS . . .



IN THE HEAVYWEIGHT CHAMP OF THE CRANKSHAFT WORLD—THE WICKES DOUBLE SPINDLE CRANKPIN LATHE

Planned, engineered weight gives the WICKES Double Spindle Crankpin Lathe the rigidity so essential for heavy intermittent cuts such as rough cheeking and turning crankpins. Weight where it counts makes the WICKES MX-4 ideal for accurate, smooth finish turning, spacing and filleting . . . provides precision accuracy in stroke, index, diameter and spacing of crankpins. A real production champ, the WICKES Automatic Double Spindle Crankpin Lathe is designed and built for machining all crankpins on two crankshafts *simultaneously* on all multiple throw automotive and similar tractor type crankshafts. With the MX-4, WICKES provides the ultimate in crankshaft production efficiency . . . and is ready to prove it . . . in steel.

The WICKES Automatic Double Spindle Crankpin Lathe, pictured here, boasts a main drive arrangement employing a worm gear, recognized for its quieter, smoother drive. Backlash is kept to a minimum, for greater accuracy, through this efficient worm gear drive and the use of compensating gears. Completely automatic, the WICKES MX-4 operates through electric push-button panels, including hydraulically operated chucks and steady rests, and is equipped with JIC approved hydraulic and electrical equipment.

world's only specialist in
CRANKSHAFT TURNING

WICKES
MACHINE TOOL

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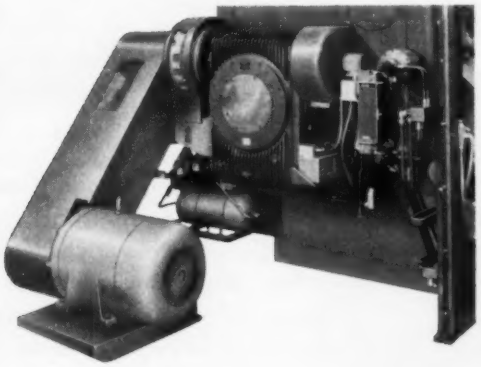

Whatever your production problem—whatever type of crankshaft you produce—rely on WICKESmanship for the most effective solution. Call on your WICKESman, or send us your blueprints and let the engineering ingenuity responsible for building and developing the world's *first* crankshaft lathe solve your production problems.

division of the
WICKES corporation

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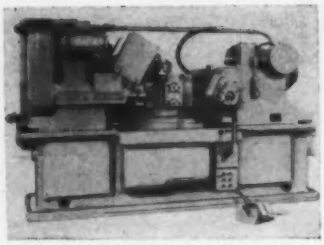
Here's what is meant by

"1·2·3"

in the

GOSS & DE LEEUW AUTOMATIC CHUCKING MACHINE



The outstanding advantage of this machine is ability to handle operations on one, two or three ends of a piece simultaneously or in sequence, *without changing set-up* or rehandling. It is the only standard machine that will do this.

"1-2-3" means ability to handle work requiring machining operations on one, two or three ends simultaneously or in sequence—a method exclusive with Goss & DeLeeuw and offered on this machine.

For complete details ask for illustrated bulletin. Send samples of your work for time and cost estimates.

GOSS & DELEEUW QUALITY PRODUCT-QUANTITY PRODUCTION

GOSS and DE LEEUW MACHINE COMPANY, KENSINGTON, CONN., U.S.A.

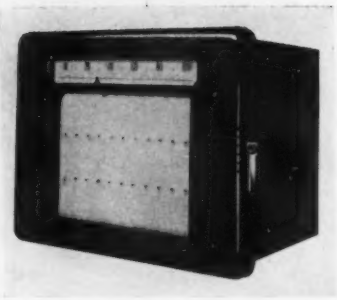


Fig. 2. Recorder with five steps of automatic zero suppression

justable-span and adjustable-zero recorder. No external calibrating means are necessary. The zero and span settings are on calibrated dials; span accuracy is 1/2 of 1 per cent of the set value, and zero settings are also accurate to 1/2 of 1 per cent. The span and zero settings can be read at a glance and permit an unknown to be measured by changing the dial settings without time-consuming calibration. One-millivolt span and one-second cross-chart speed are standard.

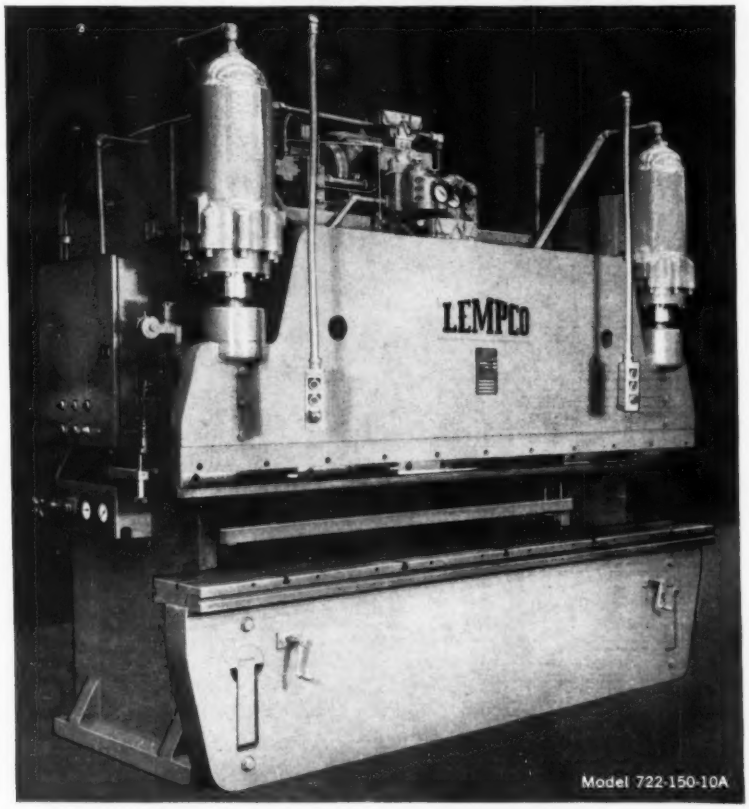
There are only three adjustments to be made—the calibrated span vernier, the calibrated zero vernier, and an arbitrary amplifier gain control. The control switches are adjustable over 100 per cent of range. The amplifier gain supplies over a 1,000,000-to-1 amplification.

The new recorder with five steps of automatic zero suppression shown in Fig. 2 is designed specifically for research and industrial laboratories. This automatic extended-range recorder has capabilities of measuring unknown and widely varying levels of potential. Having from 2 to 5 automatic steps of zero suppression, the zero is automatically shifted to accommodate any signal within a specified range. As the variable exceeds or goes below the span, the scale is automatically extended or contracted.

When the zero suppression changes, the span remains the same. Zero suppression does not affect the span. The automatic extended-range recorder is equipped with two pens, the recording pen and the step (marker) pen. The latter, which is attached at the left of the recording chart, indicates at

(*Continued on page 203*)

SEE LEMPCO...



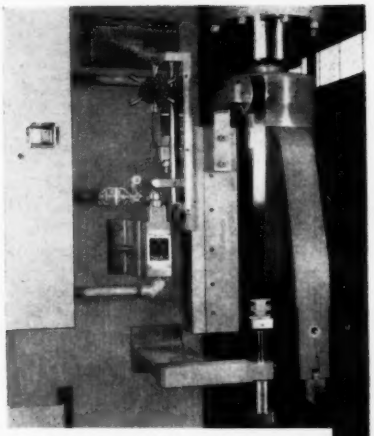
A Lempco hydraulic press brake is a production man's machine tool. Simple, rugged and accurate. Designed to put and hold the profit factor in the general run of shop work.

Offered in standard models of 75 tons capacity and upward, Series 722 hydraulic brakes are powered by the exclusive Lempco equalizing drive. No destructive shock surges, no fussy electronics. Just a good smooth and simple power drive with manifolded valving and a minimum of component parts. Frames are heavy rolled steel plate, sized to a standard of minimal deflection.

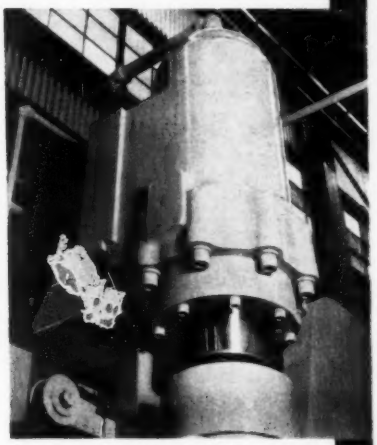
A wide line of standard and optional control features enables you to put the precision into your work that good commercial practice requires.

For more information call your local Lempco Machine Tool Division representative, or get in touch directly with the factory.

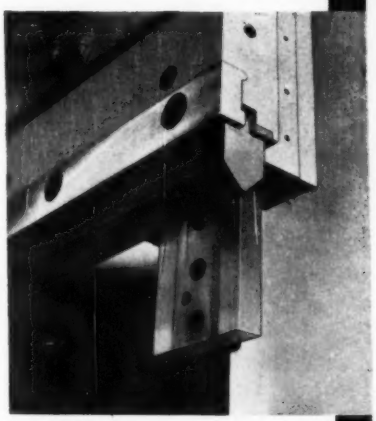
LEMPCO
MACHINE TOOL DIVISION
BEDFORD, OHIO



Stroke controls offer micrometer-precise depth stopping, adjustable limiting of ram return and slow-down to press.



Cast steel cylinders are dovetailed to the housings to hold accurate alignment under load.



Accurate, adjustable ram ways have bronze liners sliding smoothly against gibs bolted to the housings.

..."engineered-for-the-customer" products from the Lempco family of industrial equipment

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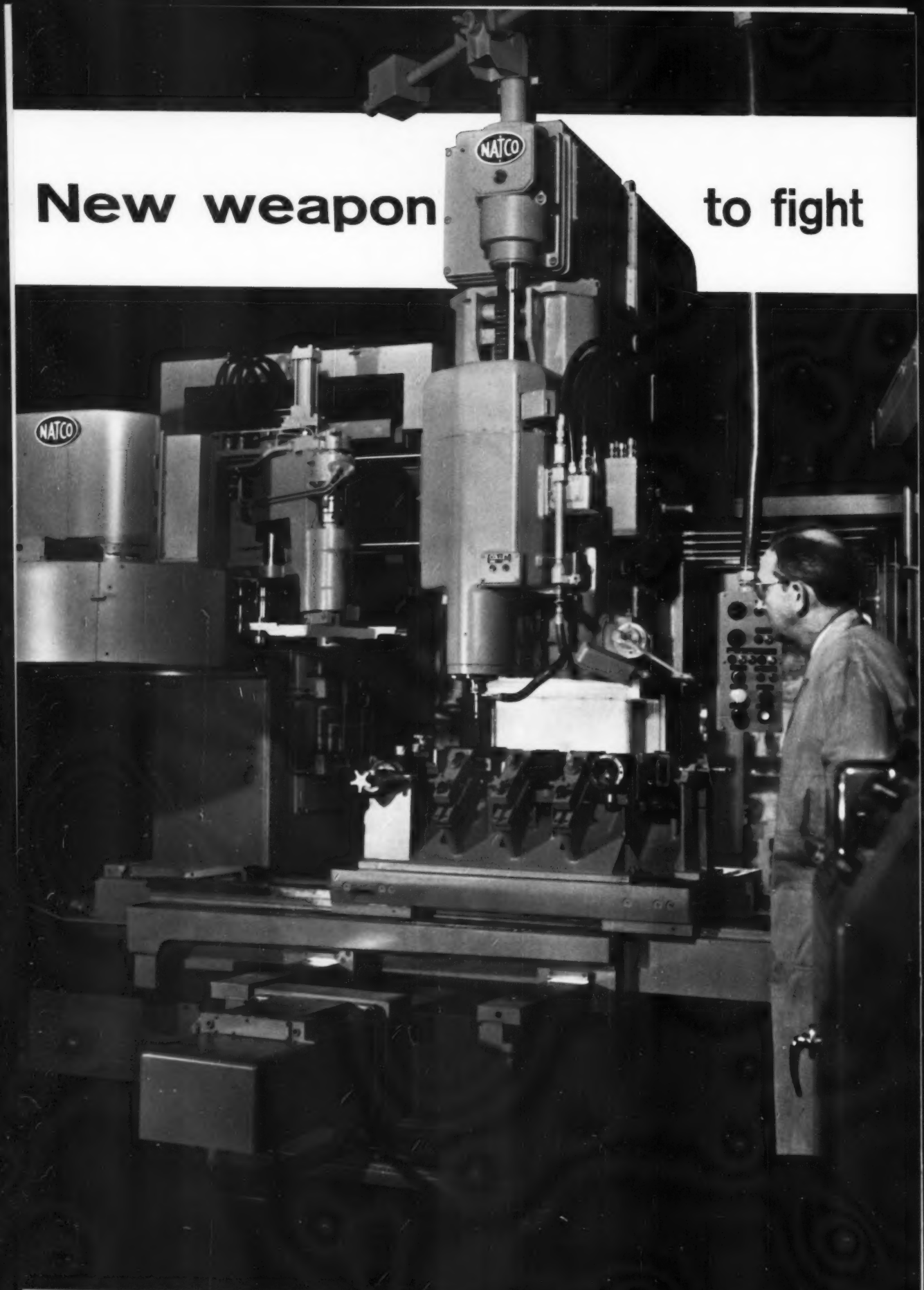
New weapon to fight



profit squeeze

Start profits on the upswing by wringing the water out of drilling, tapping, and milling costs. This new Natco Drilling-Tapping-Milling Machine—with Automatic Tool Changing and Natcotrol—is just the machine to do it.

Virtually eliminate jigs and fixtures, chop parts inventory, hold lead time to hours instead of weeks, cut your scrap rate to the vanishing point, know your costs in advance—these are the kind of savings available to you through Natcotrol—Natco's own fully electro-mechanical numerical control system.

Time wasted at the tool crib? Not any more with Natco's automatic tool changer that works without tool coding, and always holds the next tool ready for quick changing.

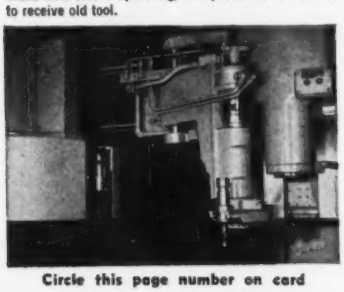
More reasons for putting Natcotrol and the Natco Automatic Tool Changer to work with Natco's powerful new Drilling-Tapping-Milling Machine, cutting your costs and widening your profit margin: Big work area, full numerical control of spindle depth and tool changing as well as table positioning, 50 - 3000 rpm, 2000 lb. thrust, 10 seconds tool changing time, 16" stroke, fast positioning, ±.001" accuracy.

Get us started on a quote for you today. There's a Natco representative in your territory ready to talk business. Write for bulletin No. 157-2.

NATIONAL AUTOMATIC TOOL CO., INC.
Richmond, Indiana

NATCO

Changer arm rotates to bring new tool into position. While new tool is operating, tool presenter will index to receive old tool.



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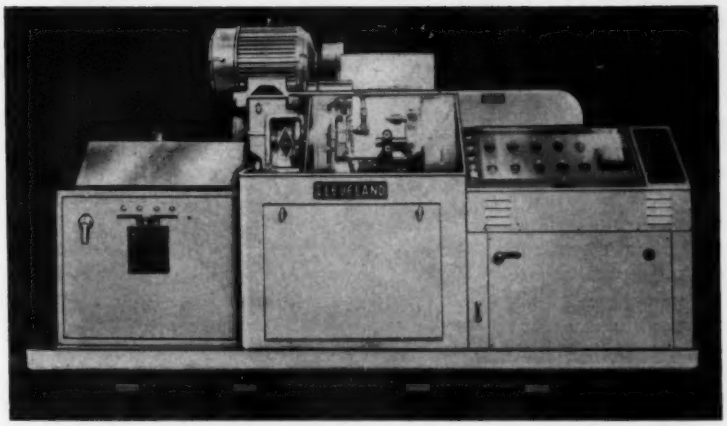


Cleveland single-spindle automatic incorporating new design features

which step of zero suppression the recorder is operating. Any span from 2 to 250 millivolts may be selected. A total span of 500 millivolts is maximum.

This instrument has an accuracy of 1/4 of 1 per cent of entire span and a sensitivity of 1/10 of 1 per cent of each span.

Circle 609 on Readers' Service Card

Cleveland Improved Single-Spindle Automatic Bar and Chucking Machine

Design changes have recently been incorporated in the Cleveland Model "AB" 3-inch single-spindle automatic manufactured by the Cleveland Automatic Machine Co., Cincinnati, Ohio. These changes have been made to further increase the setup speed and operating convenience of this combination bar and chucking machine. Among the innovations, not previously available in a single-spindle automatic, is a precision-feed monitor dial that accurately indicates turret-tool feed rates in inches per minute for each forward and return setting of the turret tools. A simple turn of a knob is all that is required to set the feed rates, and ten different infinitely variable feeds are possible in one cycle of the machine.

A separate knob is provided on the control panel for selecting the forward and return movement of each of five turret-tool positions. A conveniently located chart quickly transposes spindle speeds and feeds into dial settings.

The Cleveland 3-inch Model AB has 112 spindle speeds, ranging from 24 to 1820 rpm. A two-speed, ball-bearing motor supplies the power for the spindle and provides two automatic spindle speeds. Two additional speeds are made available by an automatically shifted disc type friction clutch, making a total of four automatic speed changes.

Another unusual feature of this automatic is its rapid conversion from bar work to a chucking machine. This easy convertibility makes the machine especially adapted for use in shops desiring flexibility and economy in handling work up to 6 inches in diameter. This is accomplished by the substitution of a simple, low-cost chucking attachment.

Circle 610 on Readers' Service Card

Engine-driven welder announced by Air Reduction Sales Co.

Engine-Driven Welders

The Air Reduction Sales Co., a division of Air Reduction Co., Inc., New York City, has recently marketed three new engine-driven

welders designed for rugged and dependable service and a minimum of maintenance requirements. A new 225-amp alternating-current, direct-current engine-driven welder—powered by a Kohler engine—will handle stick electrode welding, Heliwelding, and Aircomatic welding. The power source supplies amperages from as low as 15 to 265 amps direct current and 25 to 320 amps alternating current. This machine can be utilized as an alternating-current power plant for other applications.

Two new direct-current, diesel-engine-driven welders are recommended for field welding where rough usage is encountered. One, the "Yellow Jacket" welder, has been designed in 300- and 400-ampere rated sizes and powered by a four-cylinder, four-cycle injection type diesel engine for service on pipeline and other heavy-duty construction jobs. Steady welding current is assured even when welding above the generator rating. It also features quick response to arc starts, controlled current peaks, and high recovery voltage.

The third welder—rated at 250 amperes and utilizing a four-cycle, three-cylinder, direct injection type diesel engine—is available both as a direct-current welder and/or alternating-current power plant, or solely as a direct-current welder.

Circle 611 on Readers' Service Card

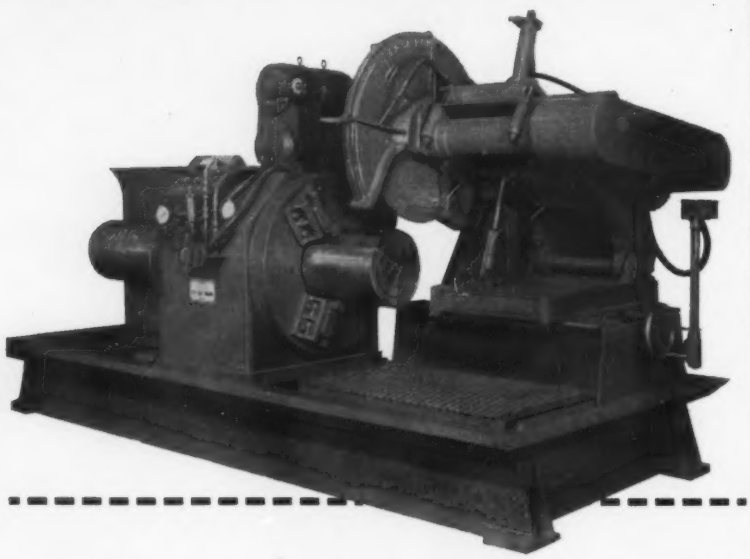
Clausing 15-Inch Drill Presses

Heavy-duty, general-purpose bench and floor drills incorporating features developed for greater accuracy, capacity, and efficiency have been announced by the Clausing Division, Atlas Press Co., Kalamazoo, Mich. These machines can be furnished with a variable-speed drive that makes instantly available any speed from 500 to 4500 rpm while the drill is running, or with a five-speed drive with speeds from 410 to 5380 rpm.

Other features include: 10- by 14-inch precision-ground tilting table, massive base with 10- by 13-inch ground working surface, positive depth stop, and front-mounted safety switch furnished with all models. The splined drive spindle is supported by two lubricated-for-life ball bearings. The precision-ground spindle is floated free from the quill by two over-

Clausing bench type drill press

NEW Abrasive Saw Rotates Metal . . . Cuts 16 to 20 IPM's on Hard Alloys

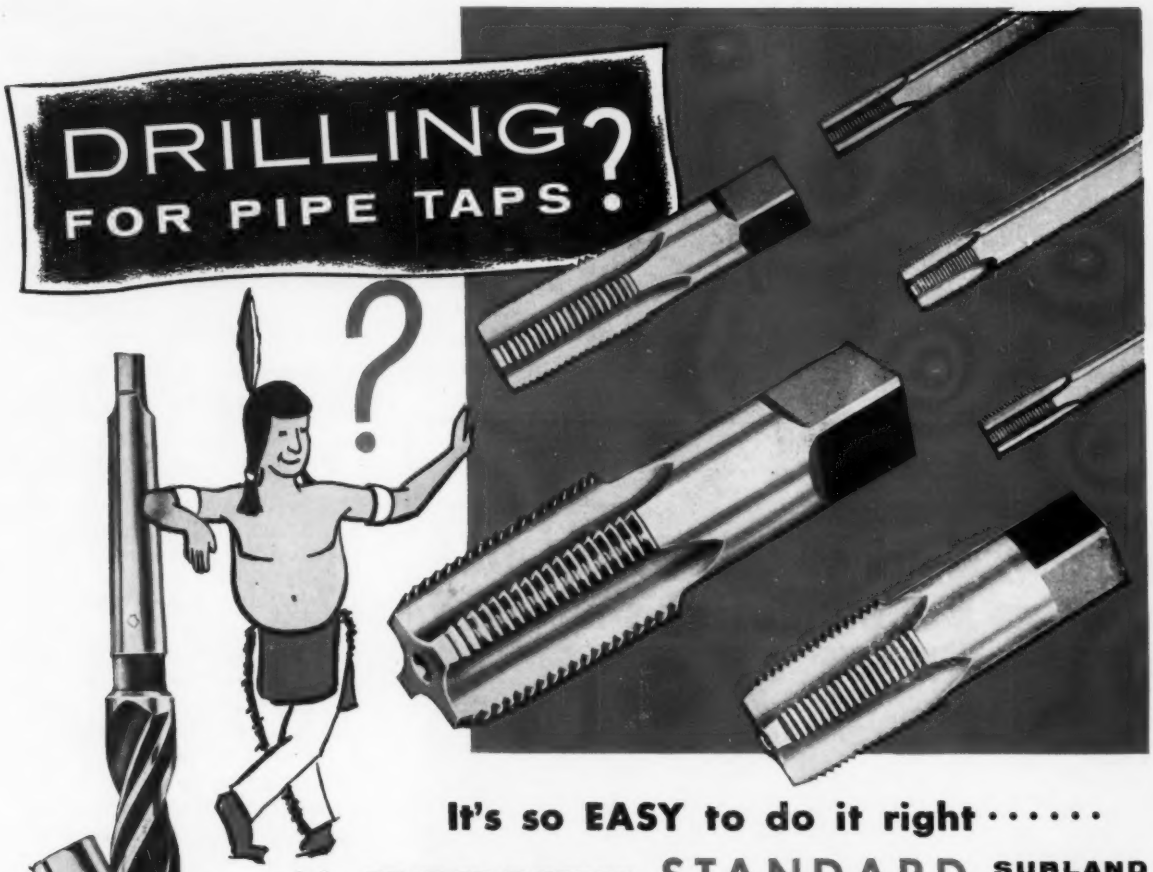


If you produce large rounds or squares, the new Rotator will reduce your cutting time to a minimum . . . 16 to 20 square inches per minute on hard alloys. It's the only rotator-type saw with a chuck that will hold rough forgings and rounds, as well as conventional rounds up to 14" diameter. Material is rotated as it is cut, keeping a cooler surface at the point of blade contact . . . result — longer blade life. Self-contained and portable, with integral tank and re-circulation pump.

Ty-Sa-Man
SINCE 1885

Write for FREE BULLETIN
TY-SA-MAN Machine Co., Inc.
1093 White Ave., Knoxville, Tenn.

DRILLING? FOR PIPE TAPS?



It's so EASY to do it right · · · · · ·

with MOHAWK STANDARD SUBLAND DRILLS

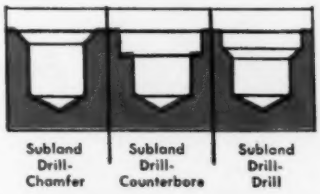
Fast and economical, too! With a Mohawk Standard Drill-Chamfer subland, you drill and chamfer simultaneously . . . all in one operation.

Think of it! You do the job *right* and save the extra tools, the jig and fixture movement, working time and eliminate tap breakage as well as scrapped parts. All this . . . plus the bonus fact that *one* Mohawk "standard" will outwork and outlast dozens of ordinary drills because Sublands have cutting flutes for each diameter, they can be resharpened (in your plant) without losing concentricity.

There's no excuse...Mohawk "standards" are available in all sizes, types or combinations in both factory and local stocks. You can start to save the Mohawk way—today!

Ready... and Waiting
...your new catalog of Mohawk "Standards" is awaiting your request.

MOHAWK STANDARD SUBLANDS are stocked in these three basic types in three step lengths and three shank styles. *All practical sizes and combinations.*



Let Mohawk prove to you that a Standard Subland is the most efficient and economical tool to use for multiple drilling operations. Check your maintenance costs along with the number of pieces per grind. Mohawk will guarantee you a provable, substantial saving.

world's largest producer of Subland Drills

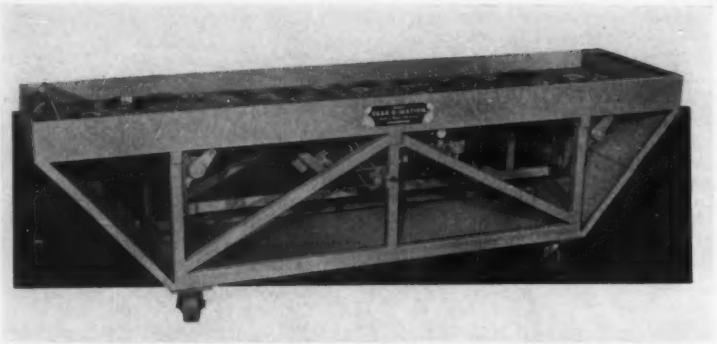
Mohawk
TOOLS, Inc.
Montpelier, Ohio

For more data circle this page number on card at back of book

sized lubricated-for-life ball bearings, and the pulleys are balanced.

These machines will drill to the center of a 15-inch circle and have a 4 3/4-inch spindle travel. Floor models have a 41 3/4-inch spindle-to-table capacity and a maximum distance from spindle to base of 47 1/8 inches. Bench-model capacities are 14 1/4 inches over tables and 19 5/8 inches over the base. A No. 2 MT spindle or 1/2-inch key chuck, and a 1/2- or 3/4-hp motor, are optional.

Circle 612 on Readers' Service Card



Portable transfer table for conveying parts from one end to the other

Buck chuck on Gisholt CRI-DAN helps make amazing savings

Photos — Acme Industrial Co., Chicago

Smart production 467% faster!

The problem: a 20 NF Class 3 thread up to shoulder in bore on hex end of 440C stainless spool valve. Tapping was slow, breakage excessive . . . hardening shrunk and distorted threads . . . rejects as high as 20%.

The solution: A CRI-DAN lathe with a Buck compensating chuck, with internal pilot bushing, to center and grip work instantly for automatic taper threading with .4675" go — .4701" no-go precision. Result: 5.03 *minutes saved per part . . . no rejects.*

In your shop, too, you'll make money *every* time you chuck with Buck.

FREE catalog write —

BUCK TOOL COMPANY

220 SCHIPPERS LANE • KALAMAZOO, MICH.

Makers of Scroll, Power, Dust Proof, Independent Chucks.

Portable Transfer Table

A portable transfer table that can be wheeled to any place in the plant has been announced by Gear-O-Mation Division, Michigan Tool Co., Detroit, Mich. The walking-beam type table can be used to convey almost any size and shape part and can also act as a mobile storage unit. In operation the table is rolled alongside a machine. As the machine operator finishes a part he lays it on the transfer table. The part is slowly and gently transferred to the other end of the table. The table top consists of a fixed grid of longitudinal steel bars alternated with a movable grid of steel bars. Air cylinders raise the movable grid slightly, slowly advance it, and then lower the grid at the end of stroke. Parts are thus lifted and carried toward the end of the table, where they accumulate against a backstop. Because of table action, delicate parts are not harmed either while being moved or by being piled up at the end. Speed of the table is adjustable within wide limits. A hand valve reverses operation and gradually returns the parts to the front of the table.

If a second operation is to be performed on the part, the filled table is rolled to the next machine, where it feeds parts to the operator's hand at the desired speed. A transfer table of proper length can be used between two machines for continuous feeding. Between operations, table and parts can be rolled out of the way as a portable storage unit.

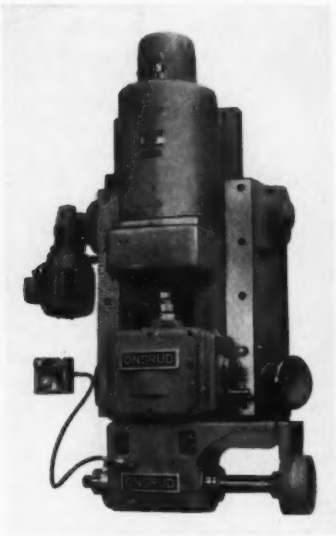
Available in various lengths, the walking-beam transfer table will

handle parts ranging from light plastic to steel castings of several hundred pounds with no adjustments. Open grid construction of the table top makes it ideal for handling oily parts or for use in handling hot castings. Air consumption during an eight-hour shift is equivalent to the amount of air exhausted from an air line open for thirty seconds. No electrical connections are needed.

Circle 613 on Readers' Service Card

Onsrud Multiple-Speed Replacement Milling Heads

The Onsrud Machine Works, Inc., Niles, Ill., has introduced a new-design milling head for old machine replacement or new machine installation. These MH-50 heads provide a large selection of milling speeds through gear-train drive for milling all materials in the ferrous to nonferrous metal range. They are built in two basic types, each with a choice of twenty or twenty-four spindle speeds. The first type has a speed range of



Onsrud MH-50 multiple-speed spindle head equipped with right-angle attachment

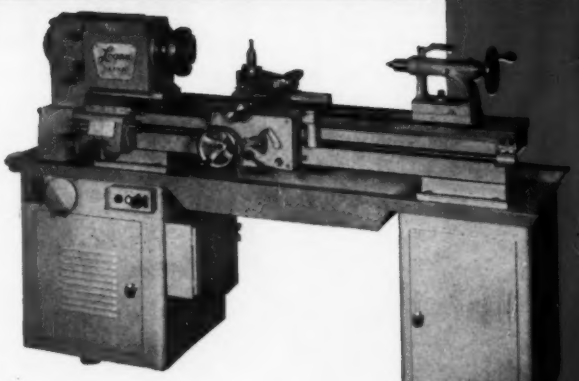
12 1/2 to 1250 rpm, and the second, a speed range of 18 to 1783 rpm. Unusual compactness in overall size is combined with high horsepower so that these units may be easily installed on an extremely wide range of milling machines for the high-speed milling of all standard metal and alloy materials.

Over-all dimensions with vertical spindle are only 54 inches high by 20 inches square; yet the spindle head provides a 50-hp drive. Two-speed drive motors are also available with a 25- to 50-hp rating. These units are built with Onsrud liquid-cooled, constant-speed electric drive motors. They are designed to mechanically and electrically meet all machine tool standards. The illustration shows a unit equipped with a right-angle attachment which is supplied, if desired, for mounting a milling cutter at a 90-degree angle to the main spindle axis. Slides are supplied to customers' specifications to meet any machine mounting requirement. Vertical positioning of the head is obtained through power drive and final manual micrometer adjustment. The power drive incorporates an "inching" feed for close approach. A locking system holds final adjustment under all operating conditions.

Circle 614 on Readers' Service Card

its specifications add up to high production capacity

Logan 14" Lathe



Logan No. 6565 14" Lathe

Logan designs greater reliability and accuracy, and longer life into its lathes by a generous combination of high-capacity features. For instance—

- An oversize spindle with 1⅝" bore turns on four super-precision ball bearings with built-in preload
- A variable-speed drive lets you change speed while work is turning—without shifting belts
- A warp-free lathe bed with high, strong walls braced by oversize ribs to withstand heaviest stresses; two V-ways and two flat ways are flame-hardened and precision-ground.

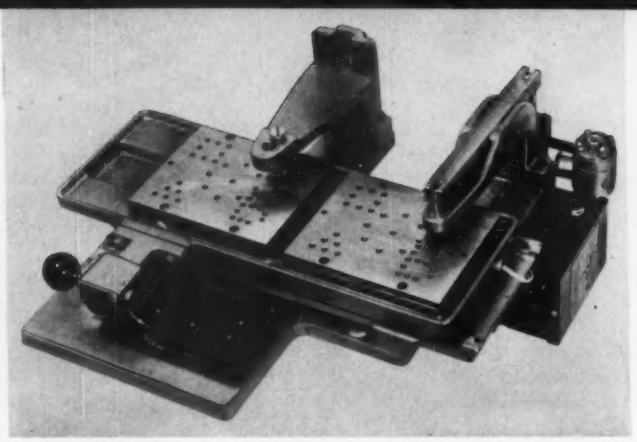
There are many more reasons why this and other Logan Lathes have a greater capacity. The complete specifications tell the story. Write for them.

- Spindle speeds to 2000 rpm
- 1⅝" Levermatic collet chuck capacity
- 14⅜" swing over bed
- 9" swing over saddle cross slide
- 40" between centers

LOGAN ENGINEERING CO. Dept. K-261 4901 Lawrence Avenue. Chicago 30, Illinois

Rapid Positioning Table for Drilling, Reaming, and Tapping Operations

A positioning table brought out by the Burgmaster Corporation, Gardena, Calif., eliminates the need for making jigs and fixtures for many precision drilling, reaming, tapping, and similar operations. This comparatively inexpensive unit is designed for accurate positioning of work on drill presses. It is particularly effective when used in conjunction with three models of the Burgmaster six-spindle turret drilling machines: the manually operated Model "1C" and bench type Model "O" with drilling capacities of 1/2 and 1/4 inch, respectively; and the automatic bench-model turret drill with power feed which has a capacity of 1/4 inch. The table working area is 4 by 5 inches, and the positioning accuracy, plus or minus 0.0005 inch.



Rapid positioning table for drilling, reaming, and tapping operations

At the release of a thumb button on the table-positioning handle, an air-operated shot pin drops into a hole in the master template, locking the table in position. This template has the hole pattern of the part to be produced, and when mounted, is in exact register with the work-holding subplate and locating template. The work-holding subplate provides tool clearance for drilled-through holes, and the locating template is mounted under the handle pointer and shows the operator at a glance the relative position of the table.

Ball-bearing mounting permits rapid table positioning with minimum effort. Where the degree of accuracy is such that bushings are required, an optional outboard support bracket with its own bushing liner can be used, eliminating the need for a fixture.

Circle 615 on Readers' Service Card

Sheffield Continuous Thin-Stock Gage

A Precisionaire gage has recently been developed by the Sheffield Corporation, Dayton, Ohio, for continuous inspection of the thickness of thin strips of metal or other hard material within a total tolerance range of 0.0002 inch without making contact with

Profit-Seeking

HEAD-HUNTERS

(Drill Head Hunters, that is)

Prefer the U. S. "PACKAGE" DEAL!

HERE'S THE PACKAGE:

A = Universal Joint Drill Head
B = Standard Adjustable Arms
C = Slip Spindle Plate (to suit your drilling pattern)
D = Fixture Adaptor Base
E = Fixture Insert (to suit your work pieces)

NOW APPLY THE FORMULAS FOR PROFITABLE DRILLING AND TAPPING

A + B = Adjustable Head versatility for short runs.

A + C = Fixed Head advantages for production runs.

A + C + D + E = Complete fixture and head package for more profitable production on long runs.

— and, it's all done with the one head!

Have your engineers talk with ours about U. S. Heads for your jobs.

Adjustable and Fixed Center Multiple Drilling Heads— Individual Lead Screw Multiple Tapping Heads

US DRILL HEAD

UNITED STATES DRILL HEAD CO.

5298 RIVER RD., CINCINNATI 33, OHIO

the strip. The standard model instrument accommodates strips up to 1 inch wide ranging in thickness from 0.0027 to 0.062 inch by means of interchangeable riser blocks. Models to check other thicknesses and widths can be supplied. Thickness is checked at three points across the width of the strip.

This new inspection instrument

Sheffield continuous thin-stock gage

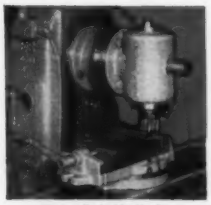
consists of a compact bench type air-gage fixture connected to a three-column Precisionaire instrument. To use, the operator pulls the strip through a noncontact air-gage head which has three pairs of opposed air jets. As the stock passes through the gage head, constant pressure and exact gaging position are maintained by means of a pair of spring-urged nonmarring Teflon guide rolls on each side of the gage head. Each pair of opposed air jets is connected to its own column in the Precisionaire instrument. With gaging amplification of 10,000 to 1, the float rises or falls a total of 2 inches in the 0.2-inch tolerance, instantly revealing any thickness deviation.

Circle 616 on Readers' Service Card

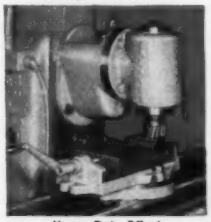
Reduced-Dimension Motor

A radial air-gap motor LO-I of flange-mounted construction has been added to the line of reduced-dimension motors made by Fairbanks, Morse & Co., Chicago, Ill. This newly developed motor, designed for the original equipment market, features minimum over-all length and reduced weight with low rotor inertia. It is intended for application where space limitations are critical and where fast acceleration, frequent start, or reversing duty is required. The new line includes ratings from 1/2 to 25 hp in speeds from 900 through 3600 rpm in three basic frame sizes. Several horsepower ratings in each mounting-flange diameter are available. Four different flange diameters may be had in 1-, 1 1/2-, and 2-hp ratings and a 13-inch diameter

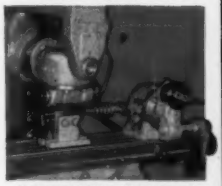
Fairbanks-Morse radial air-gap motor



Heavy Duty Vertical Milling Attachment



Heavy Duty Offset Vertical Milling Attachment



Universal Milling Attachment

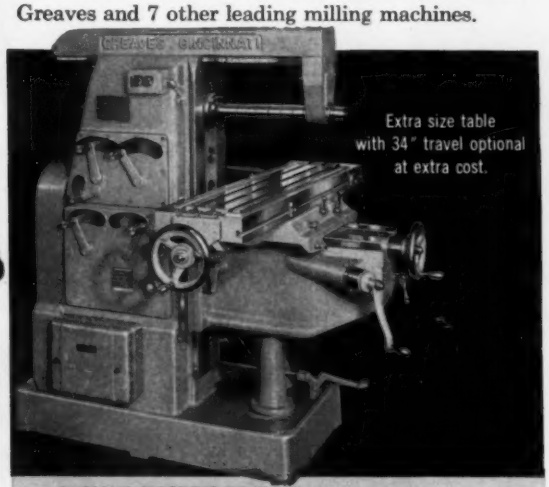
Toolmakers Overarm

Heavy duty attachments increase versatility of dependable, low-cost

GREAVES MILLS

"THE MOST MILL FOR THE LEAST MONEY"

A full line of attachments and accessories offer outstanding flexibility for all types of milling operations . . . with GREAVES MILLS. Make your own comparison of 22 specifications of Greaves and 7 other leading milling machines.



Send coupon for FREE Comparison Chart and detailed descriptive literature on easy-to-use attachments.

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___ Send Comparison Chart. I will make my own comparison of GREAVES MILLS with other makes.
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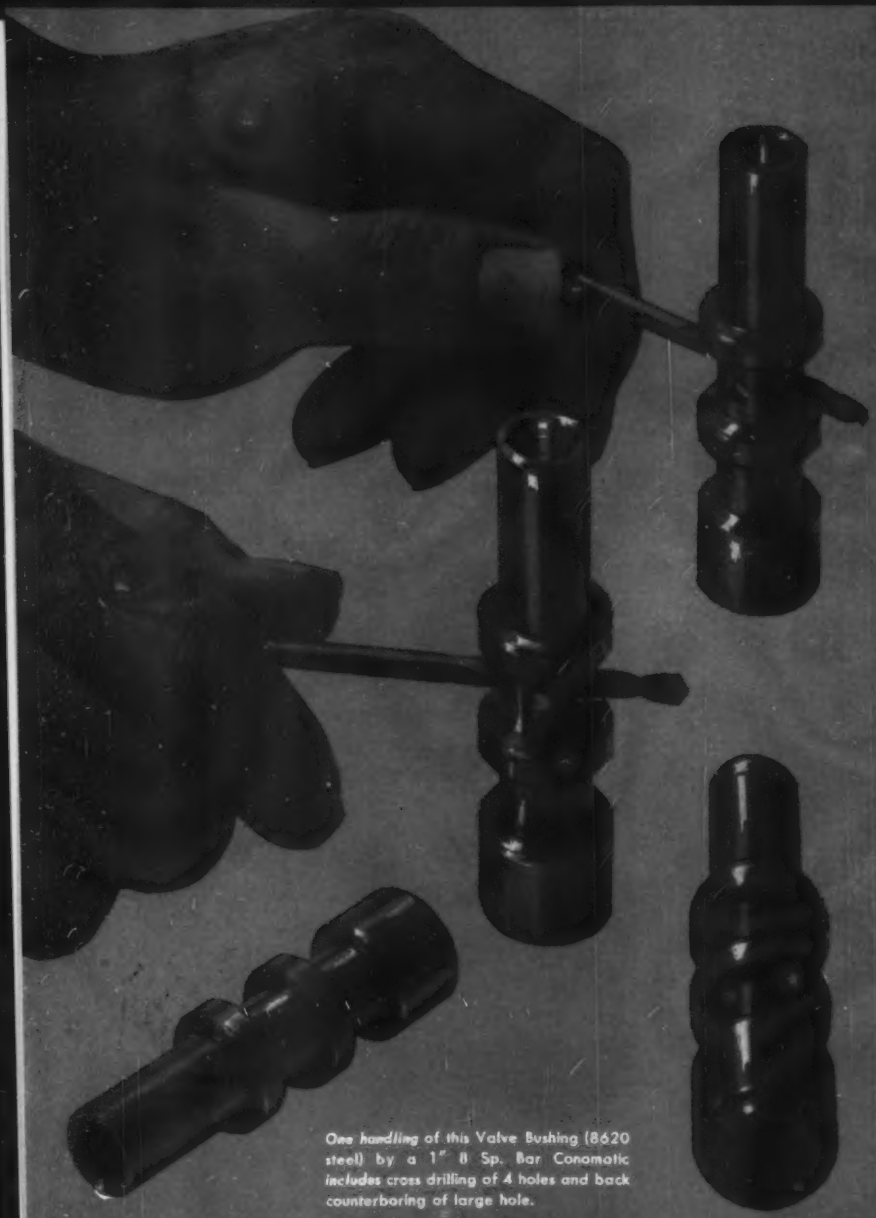
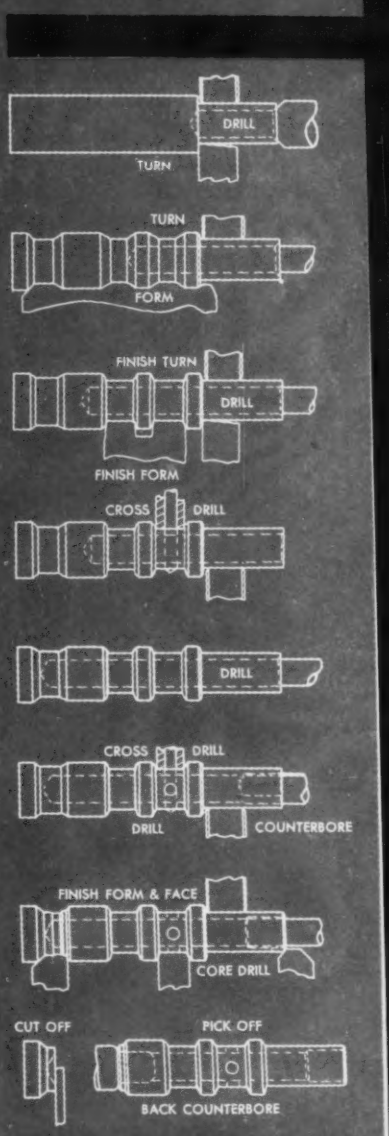
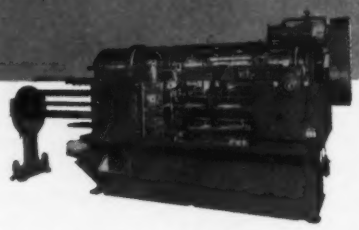


One handling of this Valve Bushing (8620 steel) by a 1" 8 Sp. Bar Conomatic *includes* cross drilling of 4 holes and back counterboring of large hole.





Those cost-saving EIGHTS!

With more work spindles and tooling positions for including — in one chucking — operations that would otherwise require the expense of second handling, you just can't *beat* THOSE COST-SAVING EIGHTS.

Likewise, as replacements of four spindle machines — on more simple work — with double stock feed and double setup, producing two pieces per cycle, nothing *compares* with THOSE COST-SAVING EIGHTS.

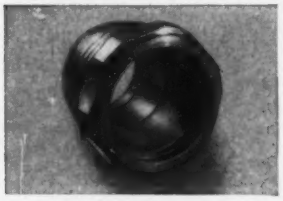
For ever-increasing work requirements — in less floor space, with less power, less coolant, less lubricant and maintenance, and less transfer and paper work — many "automatic" users are finding THOSE COST-SAVING EIGHTS more *profitable*. How about *you*?

Write, wire, or phone *today* for particulars. There is no obligation. Cone Automatic Machine Company, Inc., P.O. Box 27, Windsor, Vermont.

Conomatic

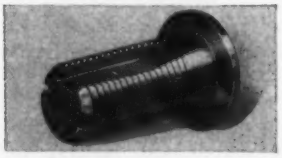
World's Most Productive Line of Automatic Lathes

Consistent, *dependable* handling of one or more of the following operations in a single setup has earned the CONOMATIC an enviable reputation as the *leader* of THOSE COST-SAVING EIGHTS: cross drilling and milling, end milling, broaching, spinning, stamping, OD and ID burnishing, eccentric drilling, turning and boring, eccentric forming, multiple hole drilling and tapping, oil groove rolling, back facing, back slotting, back hole drilling and counterboring, induction hardening and quenching.



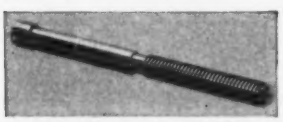
One handling **of this Ball Joint Housing (1012 steel) by a 2⅝" 8 Sp. Bar Conomatic *includes* burnishing inner ball race.**

One handling **of this Sleeve (B-1112 steel) on a 1⅝" 8 Sp. Bar Conomatic *includes* offset milling.**



One handling **of this Threaded Stud on a 1" 8 Sp. Bar Conomatic *includes* cross milling, slotting, thread chasing, and back facing (all operations without stopping the work spindles).**

One handling **of this Ball Joint (8620 steel) by a 2⅝" 8 Sp. Bar Conomatic *includes* the forming of the oil groove and deburring of the groove.**



One handling **of this 10¾" long Valve Stem (Monel Metal) by a 1⅝" 8 Sp. Bar Conomatic *includes* lead screw cutting of L. H. Acme Class III thread and burnishing of unthreaded section.**

flange may be supplied in ratings of from 1 through 10 hp. NEMA standard D flanges and axial air-gap motor (AAG) flanges are both available for maximum interchangeability. Industrial type cast-iron housings provide maximum protection to windings and resistance to corrosion. Totally enclosed, nonventilated and fan-cooled construction is available rated at 55 degrees C. Normal and high torque, continuous and intermittent duty, single multiple-speed designs are available.

Circle 617 on Readers' Service Card

Leland-Gifford Tape-Controlled Drilling Machine Speeds Printed Circuit-Board Production

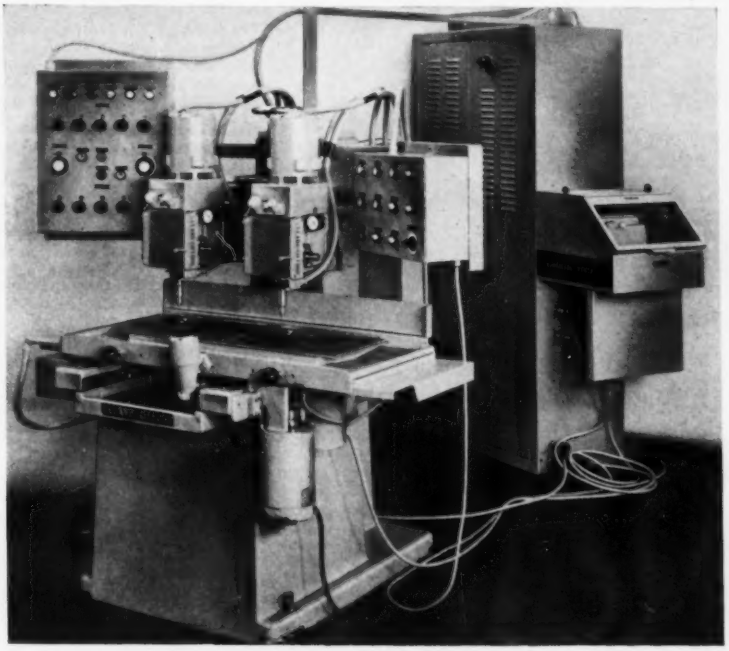
A tape-controlled drilling machine has been developed by the Leland - Gifford Co., Worcester, Mass., for rapid production of the complicated and precise hole patterns required in electronic printed circuit boards. This machine employs a modified G-E Mark II numerical positioning control with a fast tape reader which can be programmed by a Flexowriter or directly from the drilling machine using "art work" or a sample board. For the latter purpose, the compound-motion table is equipped with a 15× magnification viewer to assure accurate hole location.

Up to four self-contained hydraulic-feed drilling units can be used, adjustably mounted on the cross-rail, to drill at speeds in the range of fifty hits per minute per spindle, depending on the hole spacing. The compound - motion table is traversed hydraulically on ball-bearing-mounted and guided round ways with high-speed positioning by self-contained, closed loop, hydraulic circuits and reversible G-E Thy-Mo-Trol-controlled motor-driven pumps. Positioning accuracy is plus or minus 0.001 inch, nonaccumulative.

Each drilling unit is vertically adjustable and has an automatic cycle of rapid approach, drilling feed, and rapid return with 4 3/8 inches of available spindle traverse and 400-pound maximum drill thrust pressure. The feed rate is infinitely adjustable.

Standard table motion is 15 inches side to side and 11 inches front to back. Front-to-back motion of 19 inches can be provided if needed. Electrical feedback units indicate table position.

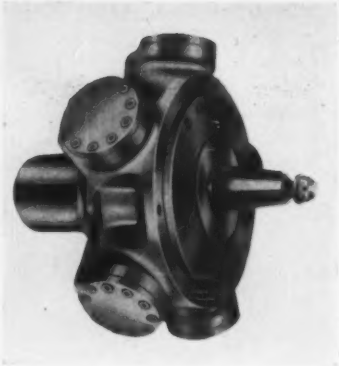
Circle 618 on Readers' Service Card



Leland-Gifford tape-controlled machine for drilling printed circuit boards

Hydraulic Motor

Staffa hydraulic motor, produced in England, now available in the United States from Double A Products Co., a subsidiary of Brown & Sharpe Mfg. Co., Manchester, Mich. The company states that this motor offers higher torque and lower speeds than fluid motors previously available. Staffa motors can be coupled directly to conveyors, rolling mills, hoists, winches, extrusion machines, and similar equipment without the use of gear-boxes. Two models are made. The seven-cylinder model operates at a continuous torque of 6600 foot-pounds and has a peak torque of 10,000 foot-pounds. The five-cylinder model offers a continuous torque of 4600 foot-pounds and has a peak torque of 7000 foot-pounds. Variable speeds range from 0 to 75 rpm (seven-cylinder), and 0 to 100 rpm (five-cylinder model). In both models the directon of rotation may be changed quickly by means of a control valve.



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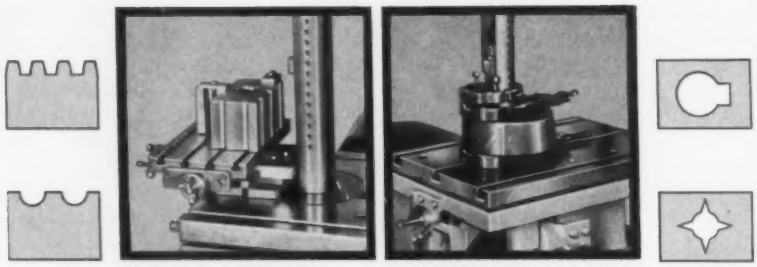
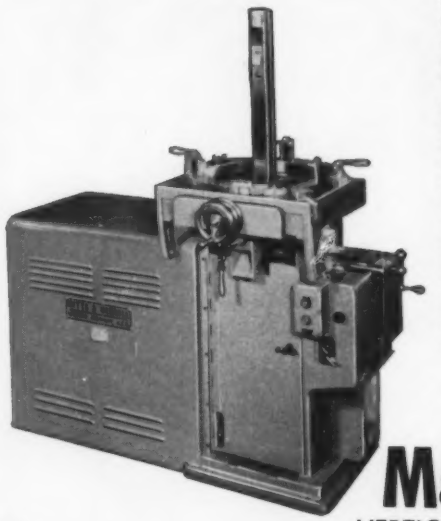
PERFORM SPECIAL PRODUCTION JOBS
ON HYDRAULIC M&M KEYSEATER
AND VERTICAL CUTTING MACHINE



Set-up for external cutting

Set-up for internal cutting



The new Mitts & Merrill Keyseater and Vertical Cutting Machine can be easily adapted to cutting splines, serrations and die profiles both internal and external, by adding simple fixtures.

With combination tilting table and index table, straight or tapered bores and accurately spaced multiple keyways or splines may be cut at any degree of the circle, with internal keyways up to 3" wide x 24" long.

Hydraulic drive gives smooth performance and faster machining; stroke and feed as well as tool relief are automatic, assuring exceptional accuracy.

Mechanical drive keyseaters also available. Send us prints of your cutting problems.

BUILDERS OF MACHINERY
SINCE 1854

M&M KEYSEATERS AND
VERTICAL CUTTING MACHINES

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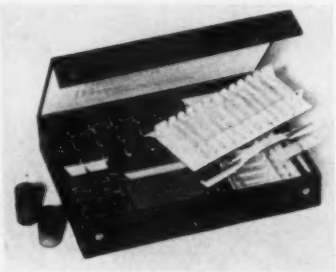
MITTS & MERRILL • 64 Holden Street • SAGINAW, MICHIGAN

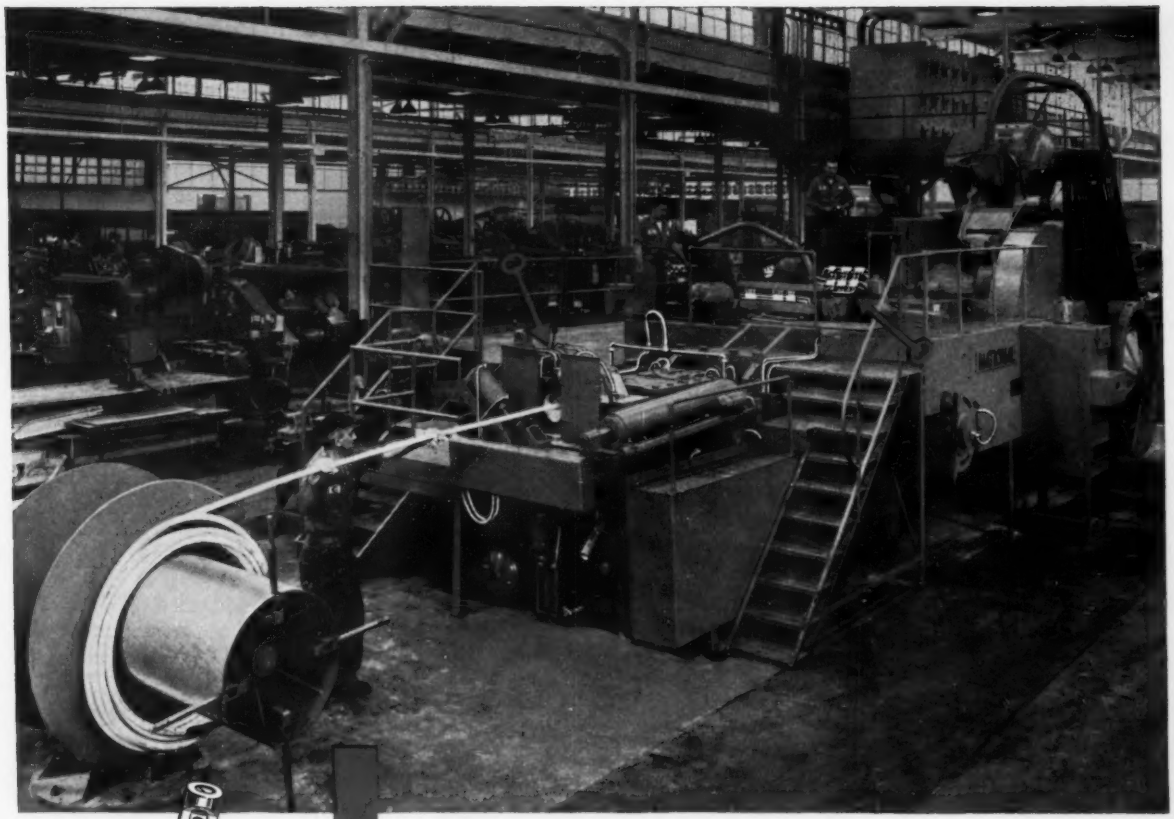


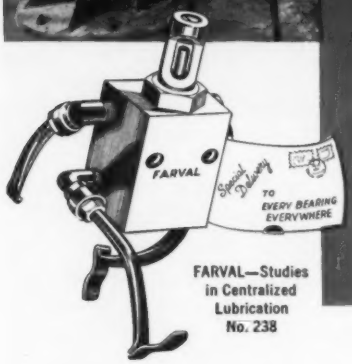
Talysurf Replica Kit for Checking Inaccessible Surfaces

Kit devised by the makers of the Talysurf to accurately reproduce surface finishes for inspection on a Talysurf or interferometer announced by Engis Equipment Co., Division of Engineering & Scientific Instrumentation, Chicago, Ill. Neatly packaged in a compartmented case, the kit comprises twenty-four jars of powder with twenty-four glass ampules of mixing liquid. Accessories include a container of solvent, a block of Plasticine, a steel file, and wooden mixing sticks. Special care has been exercised in the preparation of the liquids and powders to exclude any foreign matter that might scratch or mar the surface to be reproduced. The accuracy of this replica method has been demonstrated by critical comparisons of surfaces and corresponding replicas of such materials as glass optical flats, stainless and tool steel, titanium, copper, brass, and other metals; processing has included examples of polishing, milling, grinding, and turning.

Circle 620 on Readers' Service Card

(*This section continued on page 214*)





FARVAL—Studies in Centralized Lubrication No. 238

Farval automatically lubricates 138 bearings on world's largest Boltmaker

It's a 1¼-inch cold forger, designed and built by National Machinery Co. for the Cleveland Cap Screw Co., Cleveland, Ohio. This versatile machine automatically produces hex head cap screws. It draws steel rod to wire size, cuts it to proper length, extrudes the blank, heads, trims the head, points the end and then rolls on threads, all this at the rate of 38 complete screws per minute.

A Farval timeclock-controlled, motor-driven lubricating system guarantees against failure of the machine's 138 vital bearings, as well as supplying spray lubrication for the cold-forger's chain drive. If bearings should fail on such a high output machine—production costs skyrocket, profits take a nose-dive.

Write for revised Bulletin 26-T, which shows how Farval can extend both bearing and gear life on new machinery—as well as on older equipment now in use.

Farval Division • Eaton Manufacturing Company
3276 East 80th Street • Cleveland 4, Ohio

KEYS TO ADEQUATE LUBRICATION

Wherever you see the sign of Farval—familiar valve manifolds dual lubricant lines and central pumping station—you know steel mill equipment is being properly lubricated.

For more data circle this page number on card at back of book

Specially Designed Power Drills

Short-length power drill of new line of fractional and wire-gage sizes manufactured by Whitman & Barnes, Plymouth, Mich. The drills in this line are of the same specifications as screw machine drills except for specially designed, heavier webs, which make them particularly suitable for use in portable machines. According to the manufacturer, W&B short-length power drills will withstand considerable strain and will drill successfully where full-length drills may fail. These short-length power drills are recommended for drilling truck and auto bodies, sheet metal and stainless steels, as well as general-purpose drilling.

Circle 621 on Readers' Service Card

NEW Automatic Loading and Feeding for Grieder Tube Cut-Off Machines ...4500 to 6500 cut-offs per hour!

The Grieder automatic loader and feeder holds up to 15,000 pounds of tubing and will automatically feed the entire load through a Grieder Tube Cut-Off Machine without attention from the operator. Standard stock cradle handles 22' lengths. Shorter or longer capacities are available. Note! This equipment will also feed round stock to other types of machinery.

- Grieder Tube Cut-Off Machines cut tubing of any shape to any length faster than any other machine.
- Length tolerance plus or minus .002" on light wall tubing, .003" on heavier.
- Precision clamping dies prevent tube distortion and provide clean, quality cuts. Tube does not rotate.

Write for literature. Tell us sizes of steel, copper, brass, aluminum or alloy tubes to be cut and production requirements.

GRIEDER INDUSTRIES, INC.
P. O. Box 169 • Bowling Green, Ohio

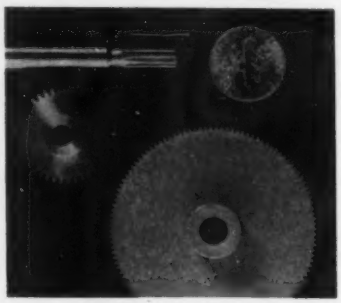
Please send bulletin describing Grieder Tube Cut-Off Machines.

NAME_____
COMPANY_____
CITY_____ ZONE____
STATE_____

Grieder
TUBE CUT-OFF MACHINES

Fine-Pitch Spur Gears

Boston Gear Works, Quincy, Mass., now manufactures a full selection of fine-pitch precision spur gears. Standard sizes run from 48 to 120 diametral pitch—10 to 40 teeth in stainless steel,

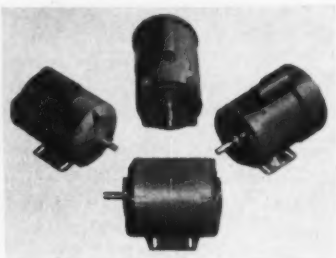


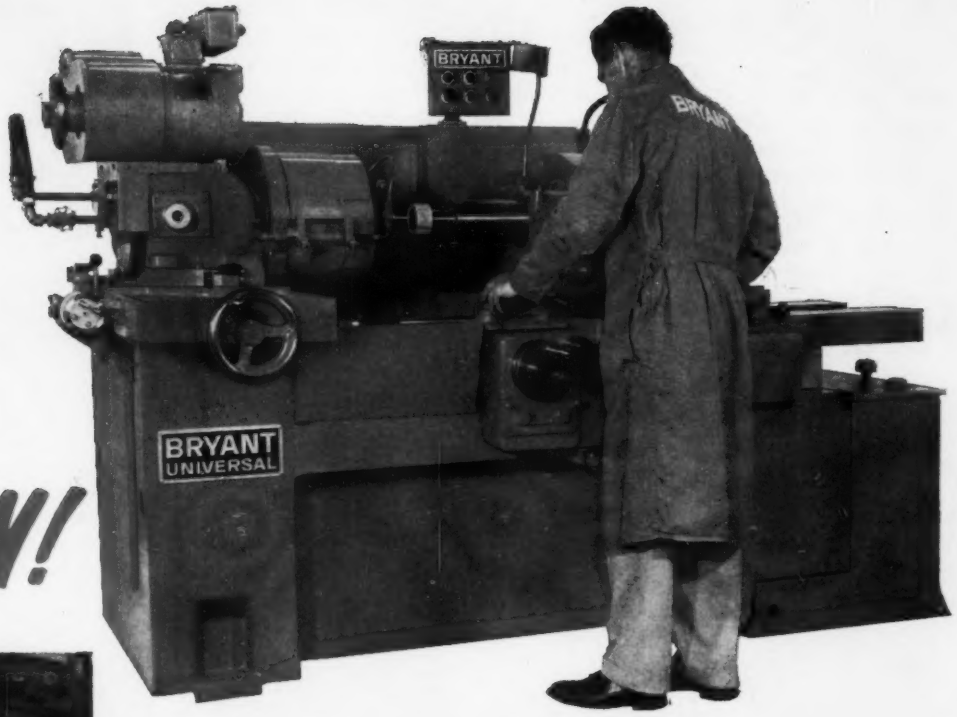
and 42 to 180 teeth in aluminum. Each gear is certified to be AGMA Precision Class 1 or better. All materials and protective finishes conform to federal and military specifications. These gears—ranging from 1/10 to 2 1/4 inches in outside diameter—are used in instruments, meters, and controls; and in precision components for aircraft and missiles, computers, and communications apparatus.

Circle 622 on Readers' Service Card

Fractional-Horsepower Motors

Fractional-horsepower alternating-current motors of new line introduced by the Master Electric Division of Reliance Electric & Engineering Co., Cleveland, Ohio. Called Duty Master motors, the new line is now available in 1/20-, 1/12-, 1/8-, 1/6-, 1/4-, 1/3-, 1/2-, and 3/4-hp ratings. Capacitor-start, split-phase, and polyphase units are made in frame sizes 48 and 56; repulsion-start, induction-run models come in frame size 56.

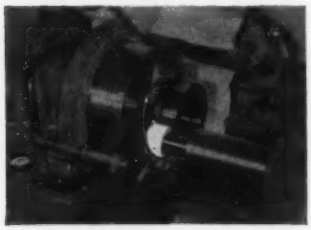




NEW!

For straight or tapered internal grinding!

For rotary ground flat surfaces!



For cylindrical or conically ground external diameters!

The BRYANT Universal Internal Grinder *A versatile machine that offers large machine capacity for internal, external and rotary face grinding.*

The Bryant Universal performs a wide range of grinding operations and — what's more important — performs them quickly and economically.

The Bryant Universal is ideal for job shops or tool rooms where a single machine capable of handling a broad variety of workpart types and sizes is required. And it's accurate too: whether you are grinding to extremely close tolerances or doing routine production work, you'll find that the accuracy of size and finish obtained with the moderately priced Bryant Universal equals that of much higher priced machines.

Among the outstanding features of the Bryant Universal are:

COMPOUND CROSS SLIDE — Placement of the cross feed slide below the longitudinal traverse slide, results in sensitive, accurate slide control through reciprocation of a much lighter mass.

MULTIPLE WHEEL SPINDLE POSITIONS — Five longitudinal and two lateral positions for the wheel spindle combine with 15½″ of cross slide travel, eliminating the need for a large selection of grinding spindles.

SWIVELING WORKHEAD — 90° pivoting of the workhead facilitates the grinding of tapers or rotary face grinding.

LARGE WORK CAPACITY — The Bryant Universal swings 12″ dia. work within the chuck guard, up to 23″ with the guard removed.

REVERSIBLE VARIABLE SPEED WORK DRIVE — Variable speeds from 150 to 750 R.P.M. provide optimum grinding conditions for all jobs.

Contact your nearest Bryant or Ex-Cell-O sales representative, and let him show you how the Bryant Universal can make the production of varied workparts profitable for you.

BRYANT Chucking Grinder Co.

20 CLINTON STREET, SPRINGFIELD, VERMONT

Internal Grinders • Special Machinery

Open protected; totally enclosed, fan-cooled; totally enclosed, non-ventilated; and explosion-proof enclosures may be specified. The steel frame with high-strength cast-aluminum alloy end shields reduces the over-all weight by one-third. Either ball or sleeve bearings may be specified. The motors may be mounted either vertically or horizontally. Built-in thermal protectors operate in the event of excessive motor temperature or excessive current input.

Circle 623 on Readers' Service Card

Tube-Flaring Tool

Parker "Ballistic Flarer" introduced by Parker Fittings & Hose Division, Parker-Hannifin Corporation, Cleveland, Ohio. This cartridge-actuated device will flare even heavy-wall stainless-steel tubing, as well as tubing of other materials and lighter walls, by explosive action. It provides the SAE hydraulic 37-degree flare (JIC standard) as used with Triple-lok and AN tube fittings. In operation, the fitting nut and

sleeve are slipped over the tube, which is placed in the tool against a stop and clamped. The cartridge is then inserted and a breechblock screwed on. A light tapping of the firing pin with a small hammer fires the cartridge. This produces a double action: first, the pressure provides a tremendous increase in the clamping force on the tubing and then the firing cone plunges about an inch, forming and coining the flare. Because the tool does not interfere, tube bends may start as close as 2 inches from the end to be flared. A complete kit includes the Ballistic Flarer in a metal carrying case with five sets of flaring dies for tubing of 1/2, 5/8, 3/4, 1, and 1 1/4 inches in outside diameter; an assortment of cartridges of different charges; and a selection of hand tools.

Circle 624 on Readers' Service Card

Thriftmaster Adjustable Drill Head

Multiple-spindle drilling of large holes in hard-to-machine material can be done with this new double-eccentric adjustable drill head made by Thriftmaster Products Corporation, Lancaster, Pa. The

Both NEW and DIFFERENT SHELDON 15" PRECISION LATHES

ER60P
5' bed—31" centers

NEW

New. Revolutionary double-box Headstock (Pat. Pend.)
New. "WORK-HOLDING ONLY" Spindle.
New. Single-Shift Back Gear Lever on Headstock.
New. Headstock and Apron running in oil.
New. 1¼" Hole through Spindle.
New. 60-pitch Gear Box with built-in Lead Screw Reverse.
New. Amazing LOW PRICE.

DIFFERENT

Different. Spindle rigidly held in two large "Zero Precision tapered roller bearings arranged in box-type design.
Different. Electrical switches and push-button stations fully enclosed in built-in well in headstock.
Different. Two independent clutches in apron for selecting power feeds.
Different. Cam-action tailstock clamp for rapid release and instant locking of tailstock.
Different. Triple, cogged, V-belt outboard drive—eliminates intermediate shafts—delivers more power to spindle.

This is an all new lathe that bridges the gap between conventional belt driven and geared head lathes. It combines the capacity and power of a geared head with the economy and flexibility of a belt driven lathe. Available with 5', 6' and 8' bed lengths providing 31", 42" and 66" center distances.

Send in Coupon for full Information

SHELDON MACHINE CO., INC. 4246 No. Knox Ave., Chicago 41, U.S.A.

Gentlemen: Please send me information on items checked.

☐ The NEW and DIFFERENT SHELDON 15" Lathes
☐ Sheldon ☐ 10" ☐ 11" ☐ 13" Lathes
☐ 11" and 13" Variable Speed Lathes
☐ High Speed Turret Lathes
☐ Sebastian 13" and 15" Geared Head Lathes
☐ Horizontal Milling Machine
☐ Sheldon 12" Shaper
☐ Name of Local Dealer
☐ Have Representative Call

Name ..... Title .....
Company Name .....
Street Address ..... ☐ Company ☐ Home
City ..... State .....

Typical "ground all over" series 1600 "precision" bearing.

YES, the bearings illustrated are identical, except for degree of precision. Because of the precision differences, there is a substantial difference in cost . . . NICE can provide bearings incorporating any degree or combination of precision features between the higher priced "ground all over" series 1600 and the low cost "unground" series 3000.

ARE YOU PAYING FOR MORE PRECISION THAN YOUR BEARING APPLICATION REQUIRES? The specific requirements of your particular application should determine the precision features of the bearing you use.

Typical "unground" series 3000 "precision type" bearing.

COST REDUCTION is Today's No. 1 Design Problem ...and NICE Can Help Lower Costs!

PRODUCT DESIGNERS will find many cost-saving advantages in the use of NICE PRECISION, SEMI-PRECISION and UNGROUND BALL BEARINGS. Experienced NICE Engineers can not only help in the selection of the proper standard bearing, but can design "exactly right" special bearings to meet particular application requirements.

WRITE FOR CATALOG NO. 190

NICE

NICE BALL BEARING COMPANY
NICETOWN · PHILADELPHIA · PENNSYLVANIA

For more data circle this page number on card at back of book

Quality You Can Bank On!
Socket Set Screws
Socket Cap Screws
Flat Head Cap Screws
Socket Shoulder Screws
"Led-Lok"® Socket Screws
"Saf-Lok"® Socket Screws
Button Head Socket Screws
Socket Pipe Plugs
Dowel Pins
Socket Screw Keys and Kits
Blue Devil®
SOCKET SCREW PRODUCTS
Quality is something you simply can't take for granted in a product such as a socket screw. But you never have to worry about Blue Devil Socket Screw Products—quality leader for 30 years. Your Blue Devil distributor can give you immediate delivery.
S S S

NOW... SPLINE HEAD SET SCREWS in sizes No. 4 to 3/8" diameter. Minimum quantity 5,000.

Sold Only Through Authorized Industrial Distributors

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SAFETY SOCKET SCREW CO.

6513 North Avondale Avenue • Chicago 31, Illinois • Telephone ROdney 3-2020

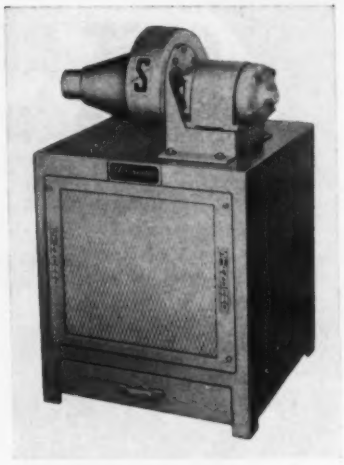
WAREHOUSES AT: LOS ANGELES • DETROIT • NEW HAVEN • NEW YORK CITY

two-spindle head with template illustrated is built to drill 2-inch diameter holes in solid steel forgings. As a size comparison, a spindle-bracket assembly from a similar head for 1/4-inch drills in steel is shown standing on the left side of the larger drill head. Each spindle of this new Super-H-D drill head can be adjusted anywhere within a radius of 7.2 inches about the drive, and a maximum center-distance adjustment of 22.4 inches is possible. The head contains No. 5 Morse taper spindles with vertical adjustment.

Circle 625 on Readers' Service Card

Dust-Collecting Unit

"Air-rester" dust-collecting unit announced by the Standard Electrical Tool Co., Cincinnati, Ohio. This unit, as recently approved for industrial use, is available in two sizes. It is a compact, self-contained, motorized unit designed to average 90 per cent dust-collecting efficiency in handling materials involved in grinding, polishing, and buffing. The unit can also be used in the removal of metal-cutting chips from milling, shaping, drilling, and other machine



tools. Inexpensive replaceable filters are of adequate area for maximum arresting of even the finest of particles and releasing of the cleaned air. Both sizes require a floor space 24 by 24 inches. If greater capacity is needed, two Air-resters can be mounted side by side to serve one wheel. The AR15 unit with 1-hp motor has a capacity of 850 cfm (cubic feet

high lubricity in water

Stuart's SOLVOL

liquid cutting compound

You may not be using soluble oils for "big chip" machining. But there is a super-lubricity compound—Stuart's Solvol—designed specifically for these jobs. A cutting fluid more and more of America's top companies are using for broaching, milling, and heavy-duty turret lathe work.

Compounded of a high-lubricity fatty oil, petroleum base, and a heavy-duty emulsifier, Solvol gives you the right combination of lubricity and cooling action for economical tool life at efficient machine speeds. Here's why . . .

Extremely fine particles of fatty oil are suspended in water like millions of delicate organisms under the sea. Fatty oil that comes from the sea—the best fat for lubricity money can buy. Solvol's high concentration of sperm oil allows chips to slide over the tool face without high friction and heat build-up. Stops chip welding and tool breakdown.

You get all these advantages in a water-mix compound that cools faster, eliminates smoke, handles a wide range of cutting operations at the lowest possible tool lubrication cost.

So, when you make the switch from straight oils to a water-mix cutting fluid, don't sacrifice lubricity. Because Solvol combines both—the cooling capacity of water, with the extra lubricity you need for economical machining.

Stuart

low friction · high finish

Stuart's CODOL liquid grinding compound

Grinding experts will tell you there's only one way to get a slick surface finish without going to extremely fine grit wheels or a straight grinding oil—and you don't have to give up wheel life or cooling action to get it.

That is by utilizing the balanced lubricating and scrubbing action of a water-mix like Stuart's Codol liquid grinding compound. For Codol's balanced formula provides the high surface finish advantages of a straight oil . . . in colloidal form . . . plus the cooling capacity of water.

Extremely fine oil particle size results in a near-transparent solution. Codol is not an opaque emulsion like most soluble oils . . . yet, it has none of the machine maintenance disadvantages of transparent compounds.

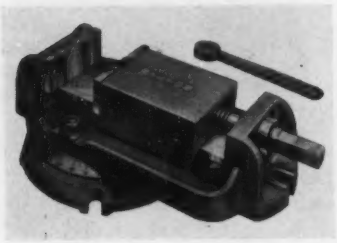
Use Codol when you want to keep grinding wheel inventory costs at a minimum and production efficiency right at peak.

D. A. STUART OIL CO., LIMITED
2727 South Troy Street, Chicago 23, Illinois

Canadian D. A. Stuart Oil Co., Limited, P. O. Box 430, 43 Upton Road, Scarborough, Ontario, Canada

per minute), while that of the AR16 unit with 2-hp motor is 1470 cfm. A wide range of optional equipment is available, including branch pipes, fittings, dust nozzles, spark traps, and wheel hoods.

Circle 626 on Readers' Service Card



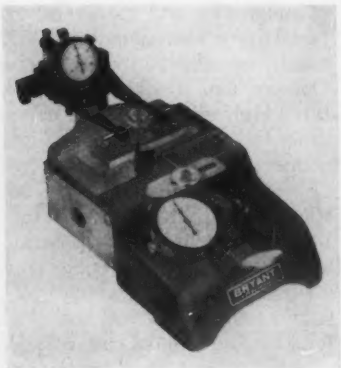
Milling Machine Vise

Completely new, 4 1/2-inch milling machine vise introduced by the Wilton Tool Mfg. Co., Inc., Schiller Park, Ill. Improved production methods are said to have reduced the cost of manufacturing this vise approximately 30 per cent. It has a generously proportioned coolant trough, a replaceable steel gib plate, and reversible steel jaw faces (one side is a smoothly ground surface and the other has vertical and horizontal V-slots). The vise comes in a stationary flanged-base model or with a graduated swivel base. The stationary-base unit weighs 50 pounds and has an over-all height of 4 3/4 inches. The swivel-base model weighs 61 pounds.

Circle 627 on Readers' Service Card

Ex-Cell-O Attachment for Thread Gages

Squareness - of - face attachment for checking smaller parts on the B-21 Bryant-Ex-Cell-O bench type thread gage manufactured by the



NEW BUCKEYE AIR GRINDER FOR PRECISE GRINDING...

NOW ONLY $88.50 complete kit

KIT INCLUDES: 1—14G air grinder, 3—nose pieces, 3—grinding points, 1—5' hose and couplings, 1—dressing stone, 3—Wrenches, 1—Vitalizer (air filter and lubricator), 1—plastic case.

Compare these Buckeye-quality features with any grinder in its class.

- COMPACT, WELL BALANCED, only 3⅞" long and 13/16" dia.
- LIGHTWEIGHT, only 5 oz.
- INFINITE SPEED CONTROL, RING THROTTLE, 0 to 50,000 RPM.
- CAPACITY, ½" mounted points.
- RUGGED CONSTRUCTION, one-piece all steel motor housing, large precision ball bearings supporting one-piece spindle.
- STURDY VANE-TYPE AIR MOTOR delivers maximum power with minimum air volume.
- QUIET OPERATION at all speeds.
- 1/8" or 3/32" collets.

Recommended working air pressure 90-100 P.S.I.

AVAILABLE AS COMPLETE KIT (illustrated) 14G-830—$88.50; COMPLETE KIT (less vitalizer) 14G-820—$67.50; GRINDER with 3 nose pieces and 2 collet wrenches only, 14G-810—$60.00.

ORDER DIRECT FROM FACTORY OR CONTACT YOUR LOCAL BUCKEYE REPRESENTATIVE TODAY!

Buckeye Tools CORPORATION

P. O. BOX 966 DAYTON 1, OHIO

Ex-Cell-O Corporation, Greenville, Ohio. This attachment checks the squareness of faces and shoulders of parts in relation to internal or external threads or diameters of the part. Exceptional accuracy is assured since the gaging segments hold the part firmly on the flanks of the thread in the same way that it is held by the mating part in the assembly. Indicators are available with graduations reading to either 0.0005 or 0.0001 inch. Accuracy and repeatability are within 0.0001 inch. The squareness-of-face gage is adjustable vertically for different part heights. Contact arms are adjustable horizontally to suit various face diameters, and contact-finger adjustments provide a fine setting.

Circle 628 on Readers' Service Card

Desmond Duplex Dresser

Grinding-wheel dresser with a double cutter unit designed for dressing and truing straight-faced grinding wheels used on flexible shaft and portable grinders. This

equipment, made by Desmond-Stephan Mfg. Co., Urbana, Ohio, will dress wheels of from 4 to 8 inches in diameter without removing them from their spindles. Cradling the revolving grinding wheel between the cutter units for a few seconds serves to dress the face of the wheel straight, remove loading, and restore the wheel's original fast-cutting action. This dresser is 2 3/4 inches high with a base 7 inches long by 3 1/4 inches wide and weighs 6 pounds. It may be bolted on a bench or any flat surface.

Circle 629 on Readers' Service Card

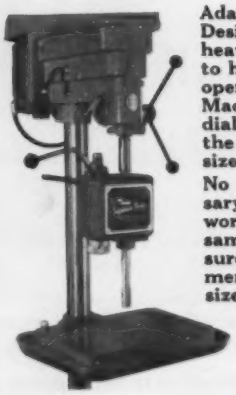
Battery-Operated Motor

Direct-current motor only 1 inch in diameter designed for use in battery-powered equipment of commercial quality, such as dictating machines, tape recorders, phonographs, and marine navigational units. This miniature HYQM motor, introduced by the Barber-Colman Co., Rockford, Ill., features high efficiency, low current drain, square brushes with pigtail connections, and is available with or without a governor and with standard self-aligning sleeve bearings or ball bearings. It is rated at 4.5 to 40 volts direct current, 1500 to 5000 rpm (governed), 0 to 0.20 ounce-inch torque, and clockwise or counterclockwise rotation.

Circle 630 on Readers' Service Card

YOU SAVE WHEN YOU BUY IT
AND SAVE WHEN YOU USE IT

MODEL VH SUPERIOR
HONING HEAD



Adaptable to most drill presses. Designed for honing work too heavy to hold on machine, and to have all the convenience of operation of Superior Honing Machines. Range 1/8" to 3". Size dial on bottom of head permits the increasing or decreasing of size while in operation.

No stopping of spindle necessary. Lever releases stone from work and expands stone to same size under spring pressure on next part. Only adjustment necessary to duplicate size is for stone wear.

Stocked in all principal cities.
Send for details and prices.

Superior Hone
corporation

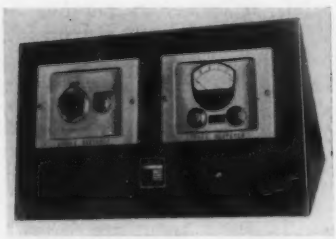
1017 Tennessee Road • Erwin, Tennessee

Dust Boots for Protection of Hand Valves

Hand valves equipped with snug-fitting, wear-resistant synthetic boots that provide maximum protection of valve-actuating mechanisms against dirt and moisture announced by the Hannifin Co.,

Des Plaines, Ill., a division of Parker-Hannifin Corporation. These boots keep dirt out of the hand toggle-head assembly without hampering normal valve operation. They are particularly suited for outdoor service, foundry applications, or wherever moisture and dust are a problem. Inexpensive initially, they are said to extend valve life while reducing maintenance and down time. The boots can easily be installed on Hannifin Series "C" and "CC" hand valves now in use.

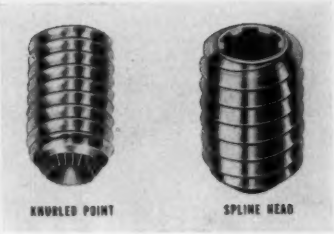
Circle 631 on Readers' Service Card



Load Control for Driving Motor

Loadtrol unit designed to provide a low-cost means of maintaining a preset load on the drive motor of process equipment and machine tools, announced by Jordan Controls, Inc., Milwaukee, Wis. It can also be used to preset web tension in a press, converter, or winder. The unit senses motor load through a shunt or current transformer in the motor circuit. The signal thus produced is matched against the control-signal setting on the Loadtrol controller shown in the illustration. If these two signals do not match, a command, proportional to the error, is given to the Shaftrol actuator. This actuator may be mounted on a variable-speed drive to increase or decrease the feed rate to the machine. It may instead be mounted on a valve or pressure regulator to control flow rate or, in web control, the brake pressure.

Circle 632 on Readers' Service Card



Socket Set-Screws

Knurled-point and spline-head set-screws recently added to the line of Blue Devil socket screws made

This, too, is 2970

PORTELVATOR®

It's a HAMILTON TOOL *use it with confidence!*

Built in response to the widespread desire for lifting and holding devices which incorporate sturdy, ***mechanical*** means of power transmission and ***multiple*** points of support; ***the very features*** which have made "standard" Portelvator the most successful device of its kind! Write for literature describing this packlifter and many other special applications of the Portelvator Power Transmission System.

Ask for FREE Bulletin No. 2970.

THE HAMILTON TOOL COMPANY

834 SOUTH NINTH STREET HAMILTON, OHIO

Versatile Winter Brothers Multi Taps answer the need for a single, effective tool for tapping of soft or annealed aluminum, magnesium, stainless steel and some types of copper.

Specially surface-treated to retard abrasion encountered in these materials, Winter Multi Taps provide exceptionally long, accurate tool life that materially reduces cost-per-hole.

Multi Taps are designed and manufactured to famous Winter **Balanced Action** tool standards. Flute contours are absolutely uniform. Chip driver contours are of maximum precision. Exact flute spacing, plus rigidly-held accuracy and concentricity of chamfers, are your assurance of peak production tapping performance. Specify Winter **Balanced Action** Multi Taps the next time you order!

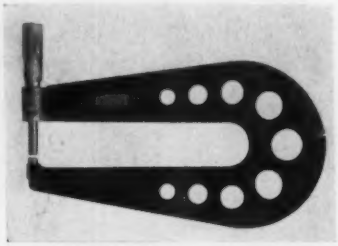
WINTER BROTHERS COMPANY Rochester, Michigan, U.S.A.
DISTRIBUTORS IN PRINCIPAL CITIES. BRANCHES IN NEW YORK
CHICAGO • DALLAS • SAN FRANCISCO • LOS ANGELES

CHOOSE FROM WINTER'S WIDE LINE OF TAPS, DIES AND GAGES

CALL YOUR
WINTER DISTRIBUTOR

by the Safety Socket Screw Co., Chicago, Ill. Socket set-screws with knurled points are available in any size and quantity, and spline-head set-screws in sizes from No. 4 to 3/8-inch in diameter can be supplied on minimum orders of 5000 or more in one size.

Circle 633 on Readers' Service Card



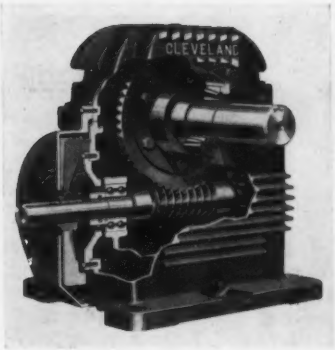
Slocomb "Speedmike" Micrometer

"Speedmike," recently added to the line of over 900 different types of micrometers manufactured by the J. T. Slocomb Co., South Glastonbury, Conn. This micrometer offers Slocomb's unique direct-reading feature, which indicates dimensions numerically in much the same manner as an automobile speedometer registers distance in miles. Reading measurement directly from three numbers appearing in the three round windows in the micrometer frame is facilitated by a magnifying glass in each window. The glass enlarges the number and prevents dust or metal particles from entering the instrument. Numbers are expressed in 0.001 inch. Graduations on the thimble provide for simple interpolation for reading to 0.0001 inch.

Circle 634 on Readers' Service Card

Worm-Gear Speed Reducer

One of a new line of worm-gear speed reducers brought out by the Cleveland Worm & Gear Division, Eaton Mfg. Co., Cleveland, Ohio. This reducer is said to offer horsepower capacities up to 80 per cent higher than reducers of the same type previously available. Thus, space savings of 50 per cent and more are made possible. The new line is available in nine sizes ranging between 3- and 12-inch center distances. Ratios extend from 4 1/7 to 1 up to 95 to 1 in ratings



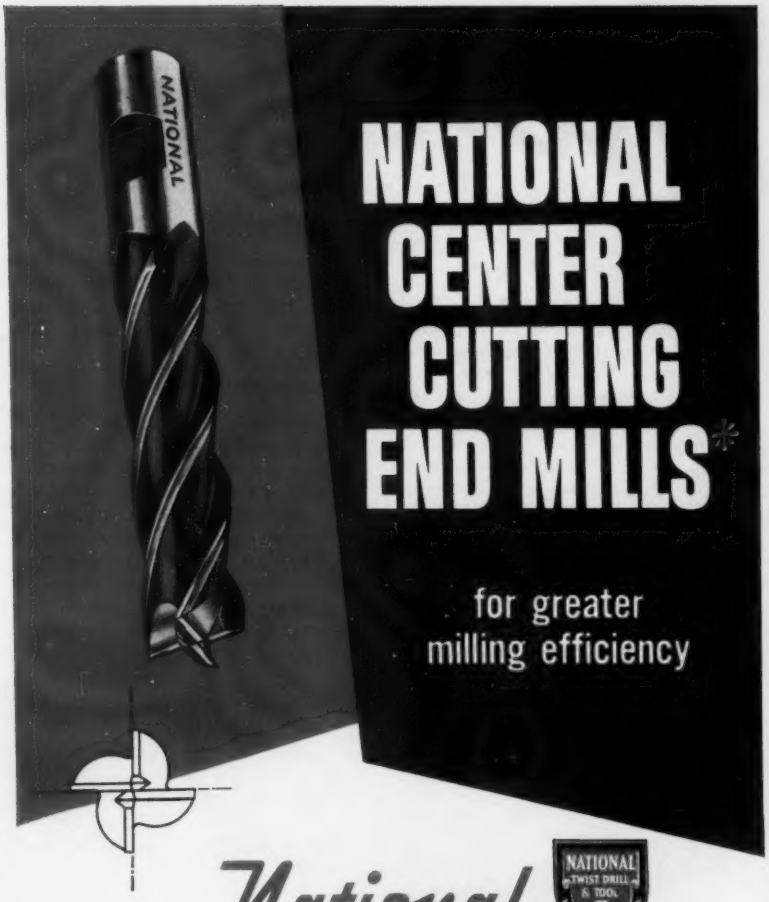
from fractional to 175 hp. Advantages of the new reducers are due mainly to fan cooling. Plastic or aluminum is employed in the design of the extremely light, specially constructed radial fan which is equally effective in either direction of rotation. The fan is mounted on the input side of the worm-shaft.

Circle 635 on Readers' Service Card

DoALL Slicing Machine

Low-priced version of precision Microtom-atic slicing machines built by the DoALL Co., Des Plaines, Ill. This Model MTM-612 machine is designed for slicing silicon, germanium, quartz, ceramics, ferrites, carbides, and other hard, brittle, friable, or shock-sensitive materials. It has a 6- by 12-inch table area, 12 1/2-inch table traverse, 6-inch cross-feed, and many of the features of the larger Microtom-atic machines. Among these are precision spindles and automatic lubrication, drive, and coolant systems. The coolant system has individual needle valves for each side of the cutter.

Circle 636 on Readers' Service Card



NATIONAL CENTER CUTTING END MILLS*

for greater milling efficiency

National

National Center Cutting End Mills can materially reduce costs on machining operations where both plunge cutting and traverse milling are required. Designed with teeth extending to the center of the tool, Center Cutting End Mills can initiate their own holes, then continue general milling of the workpiece without the need to change tools.

National Center Cutting End Mills are available in two popular series: "4300" for general purpose milling; "XM" series of specially-treated, premium steel for difficult-to-machine materials.

Center Cutting End Mills, as well as a complete line of conventional end mills, are stocked by your National Distributor. Call him today.

NATIONAL TWIST DRILL & TOOL COMPANY

Rochester, Michigan, U.S.A.

DISTRIBUTORS IN PRINCIPAL CITIES. BRANCHES IN NEW YORK CHICAGO • DALLAS • SAN FRANCISCO • LOS ANGELES

*JUST ONE OF NATIONAL'S PARADE OF PLUS PRODUCTS

CALL YOUR NATIONAL DISTRIBUTOR

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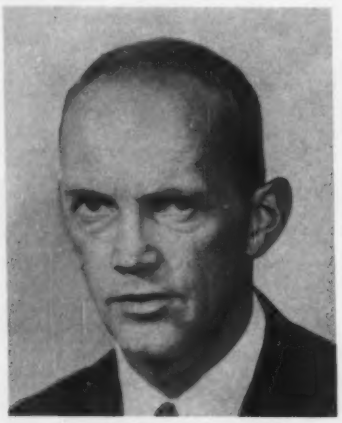
News OF THE INDUSTRY

California and Oregon

SIMONDS SAW & STEEL CO., Fitchburg, Mass., announced the opening of a new southern California branch warehouse, sales office, and service shop in Los Angeles. The new branch is a distribution, sales, and service center for southern California, Arizona, southern Nevada, New Mexico, and the El Paso area of Texas. Located at 1950 E. 20th St. in Los Angeles, it is designed and will function as a combination facility for Simonds Saw & Steel Co. and its subsidiaries, SIMONDS ABRASIVE CO. and HELLER TOOL CO. JOHN L. MERSHON, has been appointed southwest manager.

The appointment of FRANK E. HIBBARD as Pacific Coast regional manager has been announced by the



Frank E. Hibbard, newly appointed Pacific Coast regional manager, Bendix Corporation

Industrial Controls Section of BENDIX CORPORATION, Beverly Hills, Calif. Mr. Hibbard is well qualified to represent the Bendix line of numerical-control systems by twenty years of machine tool sales and engineering experience.

AIR REDUCTION PACIFIC CO., a division of AIR REDUCTION CO., INC., Portland, Ore., has moved its sales, service, and warehouse facilities into larger quarters at 1325 N. W. Kearney St., Portland. The OHIO CHEMICAL PACIFIC CO. will also have quarters in this new location.

Illinois and Indiana

THOMAS G. LANPHIER, JR., has been elected president of FAIRBANKS, MORSE & CO., Chicago, Ill., a component of FAIRBANKS WHITNEY CORPORATION. Mr. Lanphier first became associated with Fairbanks Whitney in 1960 as vice-president—planning. As president of Fairbanks, Morse, he will continue to serve concurrently as a vice-president of the parent company.

ILLINOIS TOOL WORKS, Chicago, Ill., announced that construction is now complete on the plant erected at 1901 S. Mount Prospect Road, Chicago, as the new home for its CONEX DIVISION. The 76,000-square-foot plant is expected to be in full production by February 1.

MARION TWAYNE has joined the sales engineering force of WESSON CO., Ferndale, Mich. Mr. Twayne will assist manufacturers in the Wesson mid-continent district (headquarters, Elmhurst, Ill.) with the correct application of carbide cutting tools.

AVELS SALES & ENGINEERING CORPORATION, Indianapolis, Ind., has been franchised by PARKER-HANNIFIN CORPORATION, Cleveland, Ohio, as a distributor for Hannifin hydraulic and pneumatic cylinders and air control valves and Crown air-pressure regulators, filters, and lubricators.

NATIONAL AUTOMATIC TOOL CO., INC., has purchased the Richmond, Ind., plant of the BUCYRUS-ERIE CO., Milwaukee, Wis. Natco will move from its present Richmond location, some six miles from the new plant.

Michigan and Wisconsin

SAGINAW STEERING GEAR DIVISION, GENERAL MOTORS CORPORATION, Saginaw, Mich., has established a separate actuator operation which will be responsible for the research, development, design, production, and application of ball-bearing screws and splines made by the division. EDWARD B. KOBYLZAK has been appointed manager of actuator activities. The five major subdivisions of the operation—design, production, production control, applications, and tool engineering—will be headed by DAVID A. GALONSKA, staff engineer; N. M. RANKE, general superintendent; L. J. GUNTHER, supervisor of production control; P. V. WYSONG, JR., chief applications engineer; and C. L. SANDLIN, senior tool engineer.

The promotion of ROLAND T. VOLKER to assistant sales manager—precision parts division has been announced by EX-CELL-O CORPORATION, Detroit, Mich. Mr. Volker joined Ex-Cell-O in 1948 through the sales department of a subsidiary company. He was transferred to aircraft-parts sales at Ex-Cell-O in 1951, and has remained in this work since that time.

W. F. & JOHN BARNES CO., Rockford, Ill., has opened a branch office at 18610 W. Eight Mile Road, Southfield, Mich., to handle the sale of its special metalworking machinery and other equipment in Detroit and vicinity. District manager is CHESTER (CHET) S. JOHNS. Working with him is H. J. (JOE) WRIGHT, sales engineer.

VICKERS INCORPORATED, division of SPERRY RAND CORPORATION, Detroit, Mich., has announced the signing of an agreement with ROSAEN CO., Hazel Park, Mich., under which Vickers will market the Rosaen line of "Tell-Tale" hydraulic filters.

BENJAMIN W. HUBBARD has been made sales engineer on automated special machine tools for SNYDER CORPORATION, Detroit, Mich. In 1956 he was named chief sales proposal engineer, a position he held at the time of his new appointment.

CURRIERS' TOOL SUPPLY CO., Milwaukee, Wis., has been appointed a selected distributor of micrometers and industrial measuring instruments

HUMAN EAR
No longer needed
to
SOUND-TEST GEARS

The inspector's hearing and his judgement have not always been dependable in discriminating between gear noise which may be tolerated and that which may not. In fact, these human qualities are not consistent even in the same individual at all times.

To avoid such inconsistencies, the Red Ring Sound Tester may now be equipped with an electronic broad-band amplifier. Sound intensity is measured and the result indicated on a graduated visual scale. Thus, it is simple to establish sound tolerance limits independent of the human equation and maintain uniform quality.

SPUR AND HELICAL GEAR SPECIALISTS
ORIGINATORS OF ROTARY SHAVING, GEAR HONING AND ELLIPTOID

For further information write for Bulletin C 60-8

NATIONAL BROACH & MACHINE CO.

5600 ST. JEAN • DETROIT 13, MICHIGAN

WORLD'S LARGEST PRODUCER OF GEAR SHAVING AND HONING EQUIPMENT

For Quality and Economy Use

MALLEABLE

For Service Contact...

CONNECTICUT
Connecticut Mall. Castings Co., New Haven 6
Eastern Malleable Iron Co., Naugatuck

DELAWARE
Eastern Malleable Iron Co., Wilmington 99

ILLINOIS
Central Fdry. Div., Gen. Motors, Danville
Chicago Malleable Castings Co., Chicago 43
Moline Iron Works, Moline
Moline Malleable Iron Co., St. Charles
National Mall. and Steel Castings Co., Cicero 50
Peoria Malleable Castings Co., Peoria 1
Wagner Castings Company, Decatur

INDIANA
Albion Malleable Iron Company, Muncie Division, Muncie
Link-Belt Company, Indianapolis 6
National Mall. & Steel Castings Co., Indianapolis 22

IOWA
Iowa Malleable Iron Co., Fairfield

MASSACHUSETTS
Belcher Malleable Iron Co., Easton

MICHIGAN
Albion Malleable Iron Co., Albion
Auto Specialties Mfg. Co., Saint Joseph
Cadillac Malleable Iron Co., Cadillac
Central Fdry. Div., Gen. Motors, Saginaw

MINNESOTA
Northern Malleable Iron Co., St. Paul 6

MISSISSIPPI
Mississippi Malleable Iron Co., Meridian

NEW HAMPSHIRE
Laconia Malleable Iron Co., Laconia

NEW YORK
Acme Steel & Mall. Iron Works, Buffalo 7
Frazer & Jones Company Division Eastern Malleable Iron Co., Solvay
Oriskany Malleable Iron Co., Inc., Oriskany
Westmoreland Mall. Iron Co., Westmoreland

OHIO
American Malleable Castings Co., Marion
Central Fdry. Div., Gen. Motors, Defiance
Dayton Mall. Iron Co., Ironton Div., Ironton
Dayton Mall. Iron Co., Ohio Mall. Div., Columbus 16
National Mall. and Steel Castings Co., Cleveland 6

PENNSYLVANIA
Buck Iron Company, Inc., Philadelphia 22
Erie Malleable Iron Co., Erie
Lancaster Malleable Castings Co., Lancaster
Lehigh Foundries Company, Easton
Meadville Malleable Iron Co., Meadville
Pennsylvania Malleable Iron Corp., Lancaster

TEXAS
Texas Foundries, Inc., Lufkin

WEST VIRGINIA
West Virginia Mall. Iron Co., Point Pleasant

WISCONSIN
Belle City Malleable Iron Co., Racine
Chain Belt Company, Milwaukee 1
Federal Malleable Company, Inc., West Allis 14
Kirsh Foundry Inc., Beaver Dam
Lakeside Malleable Castings Co., Racine
Milwaukee Malleable & Grey Iron Works, Milwaukee 46

These companies are members of the Malleable Castings Council

Circle this page number on card

for J. T. SLOCOMB Co., South Glastonbury, Conn.

New England

HOLMES H. WHITMORE has been named president and chief executive officer of JONES & LAMSON MACHINE Co., Springfield, Vt. Mr. Whitmore

Holmes H. Whitmore, president and chief executive officer of Jones & Lamson Machine Co.

has been with the Jones & Lamson organization since 1941. He was appointed general manager in 1944 and elected a member of the board in the following year. In 1955 he became executive vice-president, after having served successively as treasurer and vice-president.

NORTON Co., Worcester, Mass., has announced the following appointments: RUSSELL P. HOOK has been named chief engineer of the company's machine tool division, with STEWART S. MADER succeeding

Russell P. Hook, chief engineer—machine tool division, Norton Co.

Stewart S. Mader, machine development engineer, Norton Co.

him as machine development engineer. Mr. Hook joined the division's experimental department in 1937. Mr. Mader joined Norton Co. in 1930 as a junior machine designer. WENDELL C. FORSMAN has been transferred from Detroit, Mich., to the New Jersey area as an abrasive engineer. LOUIS J. BAUER has been appointed a field engineer at the St. Louis, Mo., district office, He will be succeeded in the Memphis, Tenn., area by DONALD F. CLAIR. K. DALE SWANSON, formerly abrasive engineer in Salt Lake City, Utah, has been transferred to the Los Angeles, Calif., area. He will be succeeded by EDWIN R. LARSON.

The entire business and assets of REED ROLLED THREAD DIE Co., Holden, Mass., have been acquired by UNION TWIST DRILL Co., Athol, Mass. Union plans to operate the business as a wholly owned subsidiary under its present management with no changes in personnel.

GIBSON ENGINEERING Co., Boston, Mass., has been appointed New England representative for HYDRO-LINE MFG. Co., Rockford, Ill. Gibson's territory includes Maine, New Hampshire, Vermont, Connecticut, Massachusetts, and Rhode Island.

J. T. SLOCOMB Co., South Glastonbury, Conn., announced the appointment of BERKSHIRE MACHINERY Co., Worcester, Mass.; WHITNEY TOOL & SUPPLY Co., West Hartford, Conn.; and E. S. PHILLIPS Co., Pittsburgh, Pa., as selected distributors of the Slocomb line of micrometers and industrial measuring instruments.

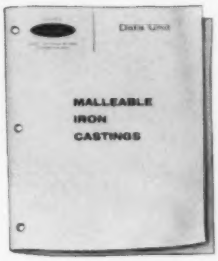
BENDIX CORPORATION'S Industrial Controls Section, Detroit, Mich., has

New Cars and Trucks Use More Malleable For Better Performance...Lower Cost

As the automotive industry steps up its drive to pack greater performance into lighter weight vehicles and still hold costs in line, the demand for Malleable iron castings continues to increase. Noted for their strength, toughness, machinability and economy, Malleables are used as key components in every make and type of vehicle.

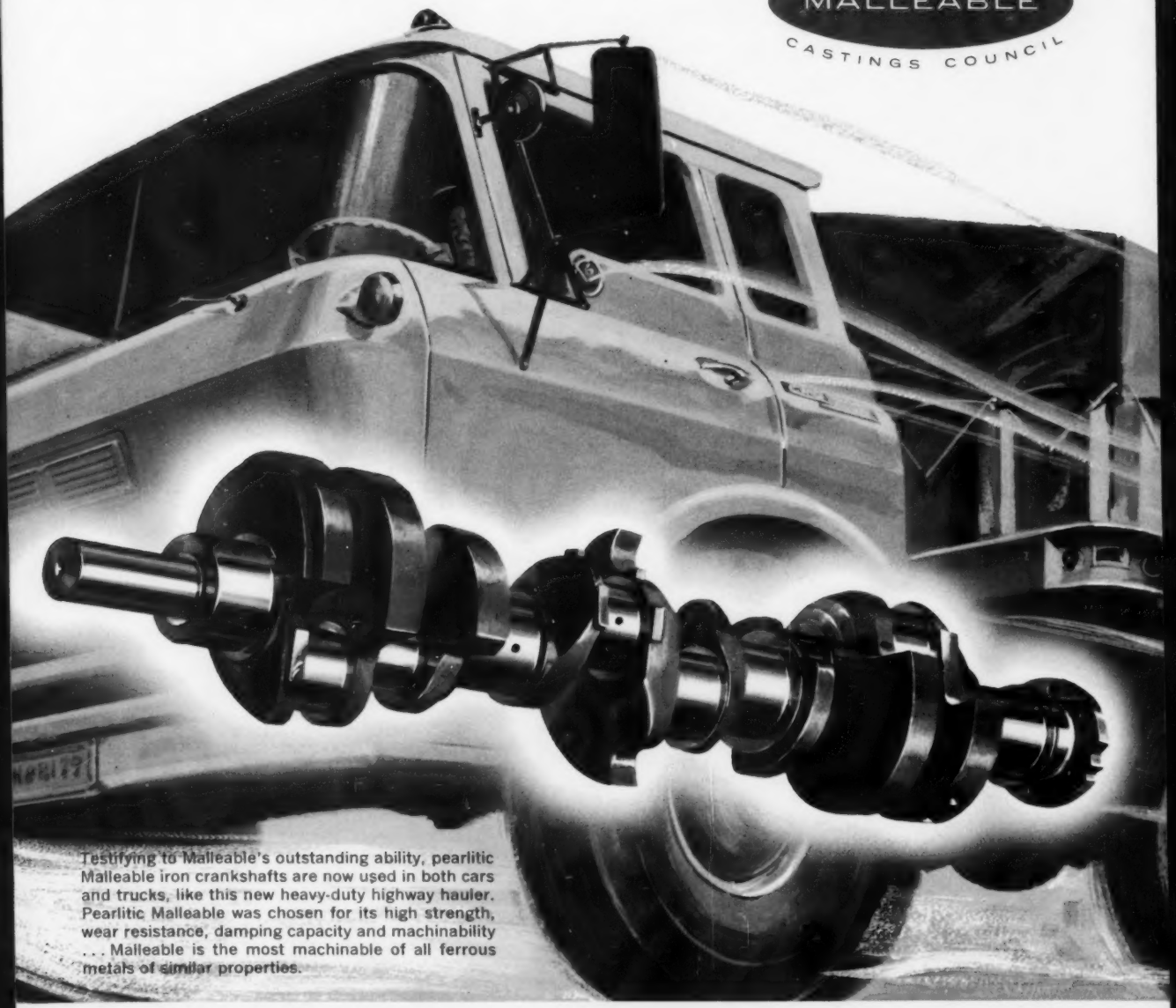
Matching each new advance in automotive technology, Malleable is now available in a broad range of properties, including tensile strengths from 50,000 to 120,000 psi!

Find out now how much Malleable castings can improve your products. Contact any company that displays this symbol —



For Free Literature on advantages of Malleable iron castings, with examples from the automotive industry, ask any member company for Data Unit No. 113, or write to Malleable Castings Council, Union Commerce Building, Cleveland 14, Ohio.

MEMBER
MALLEABLE
CASTINGS COUNCIL

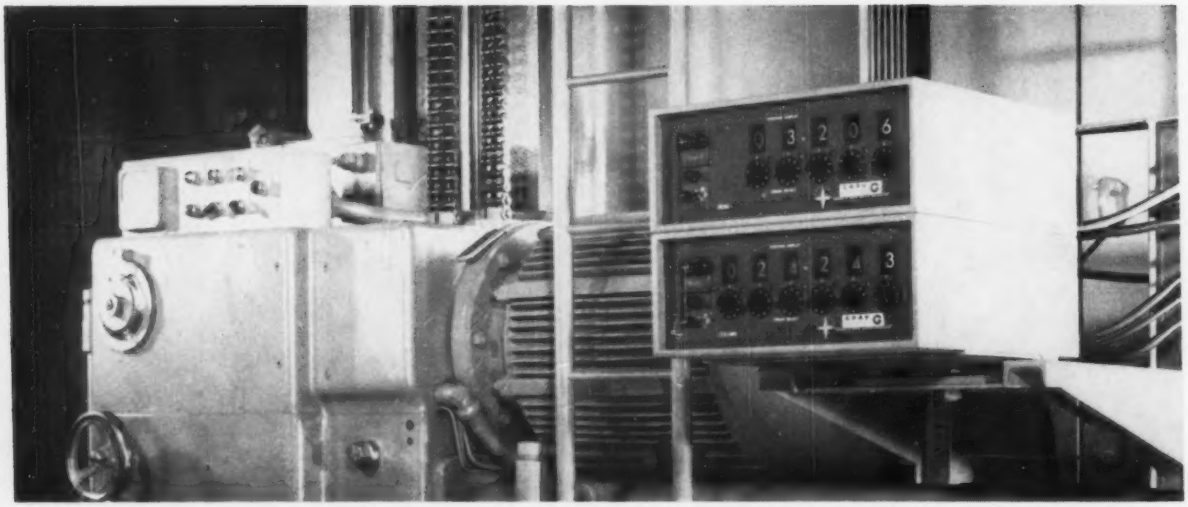


Testifying to Malleable's outstanding ability, pearlitic Malleable iron crankshafts are now used in both cars and trucks, like this new heavy-duty highway hauler. Pearlitic Malleable was chosen for its high strength, wear resistance, damping capacity and machinability ... Malleable is the most machinable of all ferrous metals of similar properties.

NORDEN Modumatic Control for New and Existing Machines

Series 100 features

- ☆ Actual Position Readout
- ☆ Decimal Display
- ☆ Full Range Origin Select



IF you have the time-consuming problem of rotary or linear positioning, then you are aware of the importance of knowing the exact location of the tool or the work piece. Up until now this was a tedious, time-consuming process requiring calculation and dial reading, both subject to human error. Norden's Series 100 display system eliminates all this and performs the calculations automatically. What's more, it can be installed on **new** and **existing** machines.

The Series 100 numerical control system utilizes a unique position feedback transducer, electronic circuitry and a visual display to indicate the **actual** position of the tool or work piece.

The **actual** position is displayed in straight decimal form by illuminated numbers that are readable from twenty feet. The display unit may be located on the machine or remote.

This Norden Modumatic system also offers a full range electronic origin select so that any desired offset can be quickly and easily dialed in by the operator on manual selector switches.

For more information about this position display system or other Modumatic control systems contact your nearest Norden Representative—400 Main Street, East Hartford, Connecticut, JAckson 8-4811, 11 West Monument Ave., Dayton 2, Ohio, BAldwin 8-4481, or write to us at the address below.

A new concept in Numerical Control

from ☆ **NORDEN** ☆ **DIVISION OF UNITED AIRCRAFT CORPORATION**

DATA SYSTEMS DEPARTMENT

COSTA MESA, CALIFORNIA

announced the opening of a regional office at 998 Farmington Ave., West Hartford, Conn. Under the direction of LEON B. MUSSER, Atlantic regional manager, the new office will serve the builders and users of numerically controlled machine tools throughout the Atlantic Coast region.

DANIEL C. MCCARTHY has been elected executive vice-president of PRATT & WHITNEY CO., INC., West

Daniel C. McCarthy, newly elected executive vice-president, Pratt & Whitney Co., Inc.

Hartford, Conn. Mr. McCarthy joined the company in April, 1960, as administrative vice-president. In his new position, he will be responsible for the activities of the sales, engineering, manufacturing, and accounting departments.

SHELDON SASLAWSKY has been appointed manager of the plastics machinery division, PRODUCTO MACHINE CO., Bridgeport, Conn. He will direct operations of the division.

New Jersey and New York

SIMONDS SAW & STEEL CO., Fitchburg, Mass., has announced the opening of a new branch warehouse, sales office, and service shop at 1160 Springfield Road, Union, N. J. It replaces Simonds old Boston, Mass., branch, serving the Eastern Seaboard from Maine to Florida; and will also be operation headquarters for HELLER TOOL CO., East Coast branch, formerly located in Newark. DAN J. O'NEIL, formerly manager of Simonds' Boston branch, has been appointed manager of the new Union branch.

AIR REDUCTION SALES CO., a division of AIR REDUCTION CO., INC.,

NEW— Thread Rolling Machine

The Reed B150 Cylindrical Die Thread Rolling Machine is a rugged general purpose two die machine. Its wide range of capacity and versatility meets the demand for both the small lot as well as mass production.

The Standard B150 Machine is arranged for multi-revolution dies with servo cam controlled in-feed operation. Work diameter capacity is from 3/16" to 5".

The B150 Machine may be arranged for high speed production by the addition of automatic work handling equipment and single revolution dies. Work diameter capacity is 3/16" to 1".

Write for Machine Bulletin B-150-1

REED ROLLED THREAD DIE CO.

Specialists in Thread and Form Rolling Tools and Equipment

HOLDEN, MASSACHUSETTS, U. S. A.

B-150-1

Sales Offices in: Buffalo, Chicago, Cleveland, Compton, Calif., Denver, Detroit, Englewood, N. J., Houston, Indianapolis, Milwaukee, Montreal, New York City, Phila., Pittsburgh, St. Louis, Syracuse, Toronto

For more data circle this page number on card at back of book

"THIS LUBRICANT SAVED US $2,098·16 IN SEVEN MONTHS"

—says THE BROWN COMPANY
Quality Paper Makers of Berlin, N. H.

"During a seven-month period before using LUBRIPLATE No. 130-AA in the bearing of our Kraft Mill Lime Kiln, we used a conventional oil at a cost of $2,134.00. In the seven months that followed, we used LUBRIPLATE No. 130-AA for initial filling and replacement at the cost of $35.84."

REGARDLESS OF THE SIZE AND TYPE OF YOUR MACHINERY, LUBRIPLATE GREASE AND FLUID TYPE LUBRICANTS WILL IMPROVE ITS OPERATION AND REDUCE MAINTENANCE COSTS.

LUBRIPLATE is available in grease and fluid densities for every purpose . . . LUBRIPLATE H. D. S. MOTOR OIL meets today's exacting requirements for gasoline and diesel engines.

For nearest LUBRIPLATE distributor see Classified Telephone Directory. Send for free "LUBRIPLATE DATA BOOK" . . . a valuable treatise on lubrication. Write LUBRIPLATE DIVISION, Fiske Brothers Refining Co., Newark 5, N. J. or Toledo 5, Ohio.

For more data circle Item 232A

New York City, has appointed J. H. BERRYMAN manager of the special products department in Union, N. J. In a concurrent move, ROBERT A. STONE was appointed sales manager of the same department. Mr. Berryman will be responsible for the development of products and processes concerning custom-built welding, cryogenic, and gas-handling equipment. Mr. Stone will coordinate sales and marketing policies of the department.

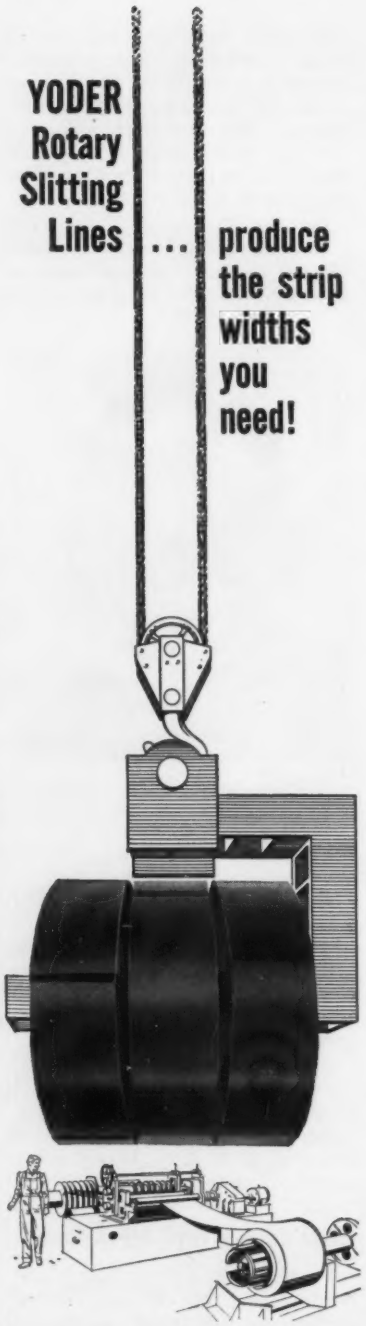
GLEASON WORKS, Rochester, N. Y., has announced the formation of major new manufacturing divisions.

Alfred J. Murrer, new assistant factory manager, machine division, Gleason Works

Donald L. Whitmore to head the new arbor, cutter, and gear division of Gleason Works

The foundry and metallurgy division will have EDGAR W. BLIEK as its manager. All machining and assembly departments concerned with Gleason machines are combined in the new machines division, directed

YODER Rotary Slitting Lines ... produce the strip widths you need!



Investigate the many advantages of YODER-engineered Slitter Installations. Write today for the comprehensive, 80 page YODER Slitter Manual ... it's yours for the asking!

THE YODER COMPANY
5304 Walworth Avenue • Cleveland, Ohio

1910 FIFTY YEARS 1960

ENGINEERING YODER MANUFACTURING ROTARY SLITTING LINES

For more data circle Item 232B

by ALFRED J. MURRER, assistant factory manager. DONALD L. WHITMORE heads the new arbor, cutter, and gear division. ARTHUR G. MATTHIES has been named chief industrial engineer to direct the industrial engineering division.

L. W. Kunkler, Buffalo district manager, Air Reduction Sales Co.

L. W. KUNKLER has been made district manager of the Buffalo, N. Y., office of AIR REDUCTION SALES CO., a division of AIR REDUCTION CO., INC., New York City. Mr. Kunkler is responsible for the sale and distribution of all Airco products marketed through the Buffalo facilities. Prior to his present appointment, he was assistant manager—engineering services, Cleveland, Ohio, district.

Ohio

FRANK IACONETTI has been appointed general manager for the Hamilton, Ohio, plant of CLEARING, a division of U. S. INDUSTRIES, INC.,

Frank Iaconetti, general manager —Hamilton plant, Clearing, division of U. S. Industries, Inc.

MORE metal removed at LESS COST

Standardize with STANDARD'S Quality

For instance . . .

STANDARD'S
Expandable, Shell-Type
REAMERS feature . . .

replaceable shells that REDUCE carbide tool costs. . .

When the Carbide-Tipped Shell has been expanded to its full limit . . . JUST REPLACE IT!

- ELIMINATE THE EXPENSE of buying complete new reamer.
- STANDARD'S Shell-Type Reamers are designed for low cost, high precision mass production.

STANDARD has available a Complete Line of Carbide Tools . . . solid or tipped.

DEPEND upon STANDARD'S Authorized Distributors . . .

For Twist Drills, Reamers, Taps, Counterbores, End Mills, Milling Cutters, Hobs, Gages, Dies, Carbides (solid or tipped) . . . and for Engineering or Technical Information.

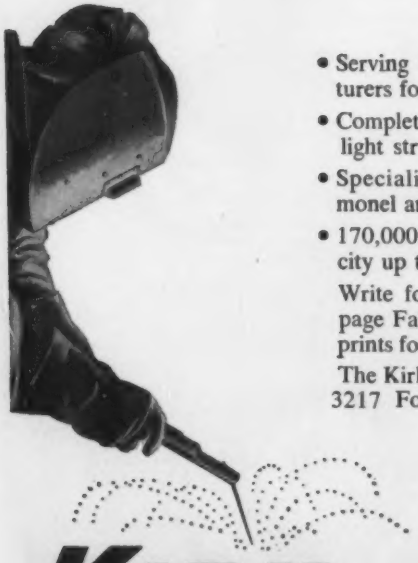
STANDARD TOOL CO.

3950 CHESTER AVENUE CLEVELAND 14, OHIO

BRANCH WAREHOUSES IN: NEW YORK · DETROIT · CHICAGO · DALLAS · LOS ANGELES · SAN FRANCISCO

Sheet Metal and Alloy Components, Weldments and Plate Work, Custom Fabricated

Machine Bases



- Serving the nation's leading manufacturers for over 50 years
- Complete facilities in sheet, plate and light structurals
- Specialists in stainless, aluminum, monel and other alloys
- 170,000 sq. ft. plant with crane capacity up to 25 tons

Write for your copy of the K&B 40-page Fabrication Catalog or send your prints for prompt quotation.

The Kirk & Blum Manufacturing Co.
3217 Forrer St., Cincinnati 9, Ohio

Custom Fabricated by

KIRK & BLUM

Chicago, Ill. Mr. Iaconetti has been with Clearing over a year.

Jefferson D. Keith, managing director, Pressed Metal Institute

JEFFERSON D. KEITH has been made managing director of the PRESSED METAL INSTITUTE, Cleveland, Ohio. Mr. Keith brings to his new position broad experience in trade association management.

PARKER-HANNIFIN CORPORATION, Cleveland, Ohio, has announced the franchisement of AIR-OIL PRODUCTS INC., Cleveland, as a distributor of hydraulic and pneumatic products to the northern Ohio industrial market. The new distributor will also handle Spanco brass fittings made by the recently acquired SPANCO BRASS CO. division in Otsego, Mich. Principals at Air-Oil Products are W. D. WYNANT, president; ALFRED I. HOLDEN; and LEON H. MARMON. Also announced was the franchisement of K. C. MOSIER CO., Dayton, Ohio, as a distributor for Hannifin hydraulic and pneumatic cylinders, Hannifin air control valves, and Parker industrial hose and re-usable hose fittings. The new distributor will be servicing customer needs throughout the lower half of Ohio and adjoining areas of West Virginia and Kentucky.

METCUT RESEARCH ASSOCIATES, INC., Cincinnati, Ohio, has organized a new data center to aid in solving aerospace machining problems. Difficult to machine materials such as tungsten and ultra-high-strength steels, and new and novel processes for removing metal, will be studied. The new department—Metcut Research Machining Data Center—will have NORMAN ZLATIN as its director and JOHN MARANCHIK, JR., as assistant director. Both Mr. Zlatin and Mr. Maranchik are vice-presidents of

CUT COSTS of

and his staff will be associated with

Metcut Research Associates, Inc., and nationally recognized authorities on machining and machinability research.

LINCOLN ELECTRIC CO., Cleveland, Ohio, has named C. O. PLANTING district manager of its Detroit, Mich., sales territory to succeed A. F. BOUCHER, who was appointed assistant general sales manager. Mr. Planting will direct the engineering sales activities of Lincoln's six-man sales staff located in Detroit and Bay City. In addition, Lincoln announces the assignment of GEORGE F. RUSSELL to its Canton, Ohio, office and the appointment of RUSSELL BOYLES as a field engineer in its Los Angeles, Calif., territory.

JOSEPH T. RYERSON & SON, INC., Chicago, Ill., has announced the addition of Reynolds aluminum to its steel service center stocks at Cincinnati, Ohio. Named manager of aluminum sales at Cincinnati is FREDERICK B. WINTHER, JR., who continues as manager of the steel sheet and strip sales department, which he has headed since 1957.

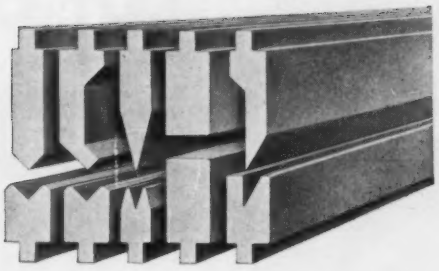
F. T. HARRINGTON has been named vice-president—marketing for FOOTE-BURT CO., Cleveland, Ohio. Mr. Harrington comes to Foote-Burt from SPERRY-RAND CORPORATION. He had an extensive career in technical and selling activities with the VICKERS INCORPORATED division of that company, where he was vice-president for twenty years.

Pennsylvania and Maryland

JOSEPH HAUF has been appointed to the new position of technical director—engineering, for the E. W. BLISS CO., Canton, Ohio. Mr. Hauf

Joseph Hauf, technical director—engineering, E. W. Bliss Co.

press brake tooling



Standard Type PRESS BRAKE DIES

62 different sizes and styles • Most in stock for off-the-shelf delivery

CHICAGO standard type press brake dies are used for a large variety of bending operations in any make or size of standard press brake. They are economical, and the quick delivery saves time in tooling up. Available in any length from 4 to 12 feet in increments of 2 feet; *induction hardened* or Diekrome steel.

The local distributors listed below offer immediate delivery on many sizes and styles of standard type CHICAGO press brake dies. If you have Bulletin STD-959 you can order any standard type die by number. Why not ask your nearest distributor for a copy? Also, if your requirements call for special multibend and forming dies, he can tell you about Dreis & Krump complete tooling service for any make of press brake.

Call your nearest distributor

ALABAMA
Birmingham
Hinkle Supply Co., Inc.
FAirfax 2-4541

CALIFORNIA
Los Angeles
Meyer Sheet Metal Mchry. Co.
MAdison 2-1477
San Francisco
Tay-Holbrook, Inc.
MArket 1-6800

GEORGIA
Atlanta
Allison Mchry. Co.
JAckson 4-1741

INDIANA
Indianapolis
E. L. Humston Co., Inc.
WAlnut 5-9691

IOWA
Bonaparte
Corry's Machine & Tool—Phone: 112

KANSAS
Wichita
Elifeldt Mchry. & Supply Co.
AMherst 7-9773

MASSACHUSETTS
Cambridge
Austin-Hastings Co., Inc.
Kirkland 7-4480

MICHIGAN
Detroit
J. Lee Hackett Co.—TRinity 2-6442
Grand Rapids
Wing and Jabaay—CHerry 1-2125

MINNESOTA
Duluth
Girard Steel Supply Co.
MArket 8-1001
Minneapolis
Minnesota Steel & Mchry. Co.
FEderal 3-6273
St. Paul
Girard Steel Supply Co.
MIdway 6-8635

MISSOURI
Kansas City
Elifeldt Mchry. & Supply. Co.
Victor 2-5494

NEW YORK
New York
Federal Machinery Corp.
CAnal 6-3022
H. Weiss & Co.
CAnal 6-4256

NORTH CAROLINA
Greensboro
Armentrout Mchry. Co.
Phone: 4-8218

OHIO
Cleveland
Wm. K. Stamets Co.
MAin 1-5124
Columbus
Vorys Brothers, Inc.
AXminster 4-4701

OKLAHOMA
Oklahoma City
Hart Industrial Supply Co.
REgent 9-2541
Tulsa
Hart Industrial Supply Co.
LUther 3-2175

OREGON
Portland
Hallidie Machinery Co., Inc.
ATlantic 2-2244

PENNSYLVANIA
Philadelphia
Delaware Valley Mchry., Inc.
OLdfield 9-4600
Milton Equipment Co.
WAlnut 2-1734
Pittsburgh
Wm. K. Stamets Co.
ATlantic 1-8091

TEXAS
Dallas
Briggs-Weaver Mchry. Co.
LAkeside 8-0311
Fort Worth
Briggs-Weaver Mchry. Co.
EDison 6-5621
Houston
Mehl Machinery, Inc.
FAirfax 3-1313

WASHINGTON
Seattle
Hallidie Machinery Co., Inc.
PArkway 3-9520

WISCONSIN
Milwaukee
Production Equipment, Inc.
GReenfield 6-6075

CANADA
A. R. Williams Mchry. Co., Ltd.

ALBERTA
Calgary—Phone: 5-4425
Edmonton—Phone: 24341

BRITISH COLUMBIA
Vancouver—TAtlow 9411
Victoria—Phone: 4-7623

MANITOBA
Winnipeg—SPruce 4-4458

NEW BRUNSWICK
Moncton—EVergreen 2-0049

ONTARIO
Hamilton—LIberty 9-8420
Ottawa—CEntral 6-3661
Toronto—RUssell 7-0521
Windsor—CLearwater 4-4762

QUEBEC
Montreal—RIverside 8-9381

9834

A Tradition of Quality and Value since 1899

Press Brakes • Press Brake Dies
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Special Metal-Forming Machines

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WALLACE BENDS

CUT COSTS of

TRIMMING

Work that formerly demanded expensive and complicated die equipment becomes a routine assignment when submitted to the Beatty Quickwork Stamping Trimmer . . . at tremendous savings in both cost and production time!

BEADING

Trimming . . . beading . . . flanging . . . forming . . . drawn shapes . . . all are within the versatile range of the Beatty Quickwork Stamping Trimmer! It trims even intricate shapes fast and accurately without burr; beads and forms in the same or separate passes!

FLANGING

Beatty Quickwork Stamping Trimmers can accommodate parts which are round, rectangular, elliptical, or, in some cases, of irregular contour . . . with no size limitations. Tooling may be simple or can be designed and automated for higher production.

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Speed? Beatty Quickwork Stamping Trimmers trim, bead, or form up to 500 blank stampings per hour. The equipment is suitable for both long and short run production, offering inbuilt quality and accuracy to assure continuous precision results!

on the

BEATTY QUICKWORK STAMPING TRIMMER

QUICKWORK . . . the word which means just exactly what it says! Write today for Beatty Bulletin No. B/Q-123, showing how Beatty Quickwork Stamping Trimmers have solved countless metal-working production problems . . . and stand ready to provide the same kind of versatile, dependable service when installed in your plant!

QUICKWORK

Division; BEATTY MACHINE & MFG. CO. 941 150th St. Hammond, Indiana

For more data circle this page number on card at back of book

and his staff will be associated with the company's administrative offices, which will move this spring from Canton to Pittsburgh, Pa. He will act as staff adviser on technical subjects to the company's top executive officers. In addition, he will assist the company's various divisions in the solution of unusual engineering and technical problems.

A. R. Margin, export sales manager, Landis Machine Co.

LANDIS MACHINE CO., Waynesboro, Pa., has announced the appointment of A. R. MARGIN as export sales manager. He succeeds J. M. MCNEAL, who has retired.

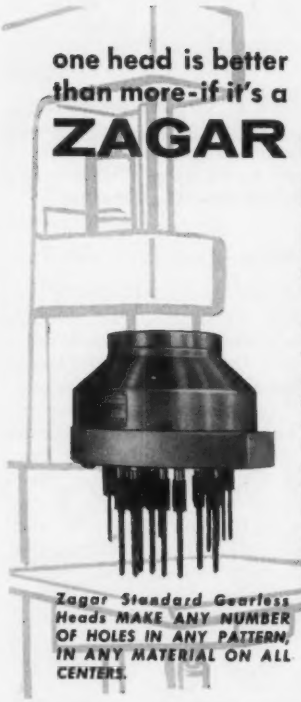
The appointment of C. EMMETT KING as project engineer has been announced by KENNAMETAL INC., Latrobe, Pa.

W. B. DOWNES has been appointed by CRUCIBLE STEEL COM-

W. B. Downes to handle executive customer relations, stainless-steel division, Crucible Steel Company of America

one head is better than more-if it's a

ZAGAR Head for Drilling, Reaming and Tapping



1 to 1000 holes in one pass —as close as twice drill diameter. Costs decrease as spindles are added. *And,* a variety of hole patterns (or parts) can be produced with *one fixed center head.* Zagar units are adaptable to standard drill presses or are built as a complete installation. Send in your hole problem to Zagar.

Zagar Standard Gearless Heads MAKE ANY NUMBER OF HOLES IN ANY PATTERN, IN ANY MATERIAL ON ALL CENTERS.

Write for Manual "M-2" for engineering data.

23888 LAKELAND BLVD. • CLEVELAND 23, OHIO

Zagar INCORPORATED

USE MORE SPINDLES TO DO MORE WORK

For more data circle item 237-A

TRIAL SAMPLE!

SPECIAL LUBRICANT EASES WORKING STAINLESS AND TOUGH METALS

New lubricant eases stamping and machining operations on the toughest metalworking jobs—takes the problems out of hard-to-work metals such as stainless, high carbon, high chrome, cast iron, monel, etc. Scientifically developed ANCHORLUBE now used extensively in a wide range of applications—drilling, tapping, spot facing, counter-boring, milling, fly-cutting, seat forming, engraving, broaching, drawing, piercing, punching, hole extruding, etc. Application by swab, spray, roller or brush. Send today for free trial sample and see for yourself how easy you can work the job with ANCHORLUBE.

ANCHOR CHEMICAL COMPANY

Dept. M-2 • 10721 Briggs Road • Cleveland 11, Ohio

For more data circle item 237-B

GEARS—ALL MAKES . . . Special and standard

PRECISION GEARS UP TO 200 DIAMETRAL PITCH

All Gears certified for Accuracy Quality and Fine Workmanship

NEW JERSEY GEAR & MFG. CO.

1470 Chestnut Ave. **Hillside, N. J.**

For more data circle item 237-C

CAMS

ALL TYPES MADE TO YOUR SPECS!

CAM CALCULATING SERVICE

Write for catalog 55-C

EISLER ENGINEERING CO., INC.
Chas. Eisler, Jr., President

738 South 13th Street
Newark 3, New Jersey

For more data circle item 237-D

WALLACE BENDS

give tubing, pipe, structural shapes and solids the contour you need for the use intended. That is why production men have been bringing bending problems to Wallace since 1896. It is the time-proved way to bend a production curve upward and a cost curve down.

WALLACE BENDERS

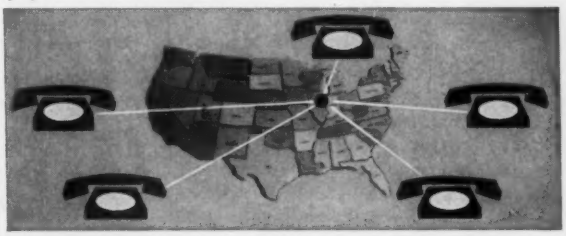
serve outstanding metal fabricators the world over, many of them exclusively. The complete Wallace line includes ram benders, rotary and roll benders, automatic and manually operated, in the widest range available. For the job you do, Wallace builds exactly the bender you need.

FROM YOUR DESK OR SHOP, ANYWHERE

CALL WALLACE COLLECT

BUckingham 1-7000, Chicago

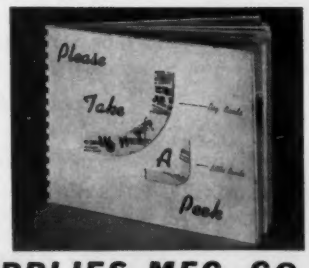
Ask for Bob Baxter. It's the quick, direct way to expert help on a bending problem. No charge to you. Wallace pays. Call Bob Baxter now.



SEE BENDING AS OTHERS DO IT

Pictures of actual bending operations abound in the Wallace "Take A Peek" Book. It's free. Get your copy.

Phone or Write
Bob Baxter



WALLACE SUPPLIES MFG. CO.

1310 W. Diversey Parkway • Chicago 14, Illinois

For more data circle item 237-E

PANY OF AMERICA, Pittsburgh, Pa., to a newly created post to handle executive customer relations for the stainless-steel division. Mr. Downes will devote his entire time to customer service covering stainless steels and high-temperature alloys.

E. W. BLISS CO. has announced plans to move its corporate administrative offices from Canton, Ohio, to Pittsburgh, Pa., where they will be located in the new Number 4 Gateway Center building. The move will be made early in March. It will not affect operations at the company's plant in Canton.

The appointment of A. WILLIAM TILDER as general manager has been announced by MORTON MACHINE WORKS DIVISION, BRAUBAKER TOOL CORPORATION, Millersburg, Pa.

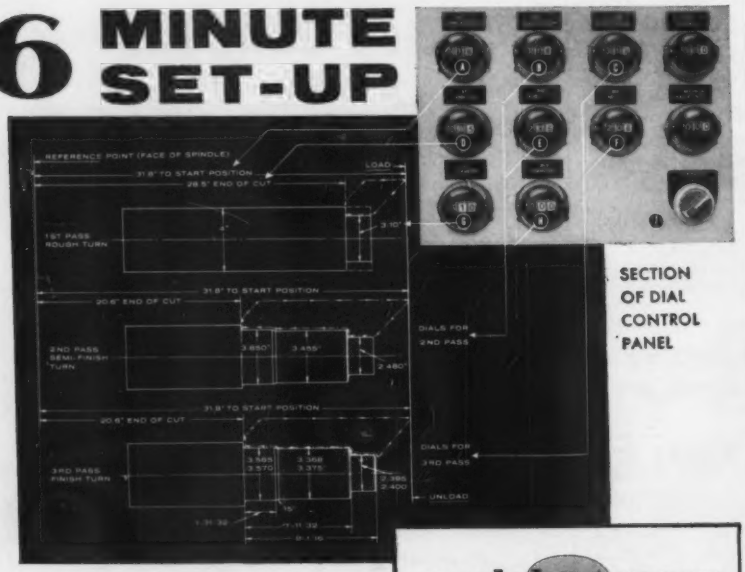
UNITED STATES STEEL CORPORATION, Pittsburgh, Pa., has made ARTHUR W. THORNTON director of engineering and research of the NATIONAL TUBE DIVISION. Succeeding Mr. Thornton at the division's Lorain, Ohio, works is WILLIAM L. FADER, who has been assistant general superintendent at that plant.

ROBERT F. COX has joined PANGBORN CORPORATION, Hagerstown, Md., as a sales engineer. He will be assigned to Pangborn's Hagerstown and Baltimore districts.

Australia

CRUCIBLE STEEL COMPANY OF AMERICA, Pittsburgh, Pa., through its wholly owned subsidiary, WORLD CRUCIBLE LIMITED, has established an Australian company—CRUCIBLE STEEL AUSTRALIA PTY. LIMITED. Land has been purchased in Bankstown, an industrial suburb of Sydney, for the construction of a warehouse. The new company will distribute the full line of specialty steel products of CRUCIBLE STEEL OF CANADA LIMITED and the United States company. GEORGE S. COX has been appointed manager of the new operation.

6 MINUTE SET-UP



SECTION OF DIAL CONTROL PANEL

SIMPLY DIAL YOUR SET-UP and the Seneca Falls Model Q Lathe is producing. Above is the geometry of a simple turning operation requiring three passes. First, dial the starting position of the cut (dials A, B, C); second, dial end of cut (dials D, E, F); and third, dial the 3.10" roughing diameter (dial G). Dial H is set at 0.00 since the second pass is a bias (oversize) cut made with tracer-template control. The tracer-template also controls the finish turn so no dial setting is necessary. Now set the selector switch I for three passes.

Machine set-up now complete; press the "cycle-start" button and you're in production. Write for Bulletin No. Q-59.

model Q tracer lathe features

- "Dial Your Set-up System" simplifies changeover.
- Multiple tools rough and tracer tools finish turn in one automatic cycle.
- Mechanical feed to all carriages.
- Templates clear of chip area.
- Easy to load and unload.
- Straight line diameter adjustment for tracer tools.
- Four speed headstock available with automatic speed change.
- Feed rate can change during cutting cycle.

SFM Seneca Falls Machine — ENGINEERED FOR PROFIT

DO tell us your troubles. If turning, centering or automation are involved, most likely we can do more than sympathize

SENECA FALLS, MACHINE CO.
SENECA FALLS, N. Y.

Coming Events

MARCH 20-24—Twelfth Western Metal Exposition and Congress, sponsored by the American Society for Metals, to be held in Pan-Pacific Auditorium, Los Angeles, Calif. For more details, contact T. C. DuMond, ASM manager of Metal Congresses, American Society for Metals, Metals Park (Novelty), Ohio.

MARCH 27-28—Third Annual Production Institute, sponsored by the American Society of Tool and Manufacturing Engineers, to be held on the campus of the University of Wichita, Wichita, Kan. For more information, contact Professor B. M. Aldrich, coordinator, University of Wichita, Wichita 8, Kan.

APRIL 18-20—Annual Welding Exposition, sponsored by the American Welding Society, to be held at the New York Coliseum. Concurrently (April 17-21), the society will hold a technical meeting at the Commodore Hotel, New York City. For more details: AWS Information Center, American Welding Society, 33 W. 39 St., New York 18, N. Y.

MAY 22-25—Design Engineering Show, to be held in Cobo Hall, Detroit, Mich. For further detail, inquire of Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y.

MAY 22-26—ASTME Tool Show, to be held in New York Coliseum.

For additional information, contact

the appendix. Sponsors other than

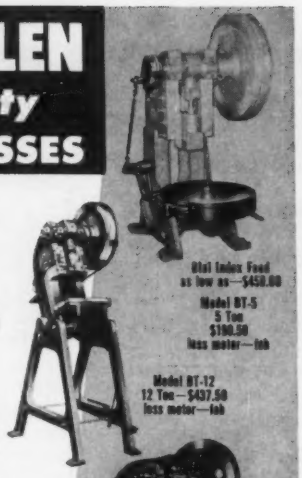
Electrical Sensing Device

ALVA ALLEN
Heavy Duty PUNCH PRESSES

Powerful Dependable and Economical Fully Guaranteed Moderate in Price

Hundreds of Different Model Combinations 1 to 25 ton capacities

See your Supply Dealer or write for Catalog giving complete information, specifications and prices on our line of Heavy Duty Punch Presses.


Dial Index Feed as low as—$450.00
Model BT-5 5 Ton $190.50 less motor—fob
Model BT-12 12 Ton—$437.50 less motor—fob
Model BT-25 25 Ton—$1087.50 less motor—fob

Thousands in Use the World Over

See the yellow pages of your telephone directory for local distributor.

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CLINTON, MISSOURI - Telephone TUrner 5-3331

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FREE PIC MASTER CATALOG 416-PAGE #21

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CLUTCHES • BEARINGS
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Ask for new Catalog #22.

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Subsidiary of **BENRUS WATCH COMPANY, Inc.**
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For more data circle item 239D

DYKEM STEEL BLUE
Stops Losses making Dies and Templates

Popular package is 8-oz. can fitted with Bakelite cap holding soft-hair brush for applying right at bench; metal surface ready for layout in a few minutes. The dark blue background makes the scribed lines show up in sharp relief, prevents metal glare. Increases efficiency and accuracy.

Write for sample on company letterhead

THE DYKEM COMPANY
2303R North 11th St. • St. Louis 6, Mo.

CUT SCRAPER TIME
END NIGHT CLEANUP & MORNING REBLUING

DYKEM HI-SPOT BLUE No. 107 is used to locate high spots when scraping bearing surfaces. As it does not dry, it remains in condition on work indefinitely, saving scraper's time. Intensely blue, smooth paste spreads thin, transfers clearly. No grit; noninjurious to metal. Uniform. Available in collapsible tubes of three sizes. Order from your supplier. Write for free sample tube on company letterhead.

THE DYKEM CO., 2303R NORTH 11TH ST., ST. LOUIS 6, MO.

For more data circle item 239B

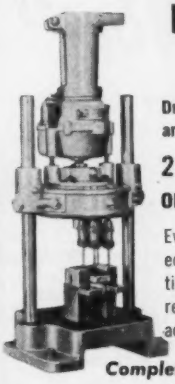
For just $3.00 you get ANSWERS!

Answers to hundreds of questions. BEND? CUT? Then you should have in your library "A Manual of Processes for The Cold Bending of Metals and Abrasive Cut-Machining of Metals."

Order yours today
WALLACE MFG. COMPANY
1310 W. Diversey Parkway Chicago 14, Illinois

For more data circle item 239C

Ettco
DRILLING and TAPPING



Multiple Spindle Heads

Drill or tap small parts faster, easier and at tremendous savings.

2 to 30 holes at one stroke on any drill press.

Every unit custom engineered from economical stock parts. These Multiple Spindle Heads fit your product requirements with "punch and die" accuracy.

***Complete Line*-Ettco has the tool for your single or multiple small hole production job.**

ETTCO TOOL AND MACHINE CO., Brooklyn 37, N. Y.

For more data circle item 239E

For additional information, contact Leonard Abrams, American Society of Tool and Manufacturing Engineers, 10700 Puritan Ave., Detroit 38, Mich.

New Books

AMERICAN STANDARD SPLINES, SERRATIONS AND INSPECTION. ASA B5.15-1960. 108 pages; 8 1/2 by 11 inches. Published by the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y., Price, $5.

This standard is a consolidation of the ASA B5.15-1950 American Standard on Involute Splines, ASA B5.26-1950 American Standard for Involute Serrations, and ASA B5.31-1953 American Standard for Involute Splines and Serration Gages and Gaging. Revisions have been made to previous spline standards to clarify usage and to include definitions, explanations of effective dimensions, and control of fits. Interchangeability with splines made to previous standards is discussed in the appendix. Sponsors other than the ASME are the American Society of Tool and Manufacturing Engineers, Metal Cutting Tool Institute, Society of Automotive Engineers, and National Machine Tool Builders' Association.

AMERICAN STANDARD SPINDLE NOSES AND ARBORS FOR MILLING MACHINES. ASA B5.18-1960. 6 pages; 8 1/2 by 11 inches. Published by the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y. Price, $1.

This standard gives the essential dimensions of spindle noses, ends of arbors and adapters, and draw-in bolt ends. A helpful innovation has been instituted in that all revisions or additions to the previous issue of the standard are box-outlined for the user's convenience. It enables the user to spot changes quite easily. New items that did not appear in the previous issue are a diagram for pilot lead on centering plugs for flat-back cutters and a diagram and table of essential dimensions for spindle noses with large flanges.

Electrical Sensing Device Stops Machine Tool If Work-Piece is Oversize

Damage resulting from oversize work-pieces in automatic and standard machine tools can be prevented by a sensing device developed by the Michigan Tool Co., Detroit, Mich. One pointer on a meter is preset to the maximum load allowed in the operation. A second pointer on the meter indicates the actual load resulting from stock on the blank.

If the load equals or is greater than the preset limit, the device automatically interrupts the machining cycle. It can do this by retracting the tool from the work or stopping the machine cycle. In any case, the device signals that something is wrong.

The sensing mechanism operates by continuously checking the armature current being drawn by the cutter-drive motor. This technique is sufficiently sensitive to register stock variations in thousandths. By occasionally glancing at the meter, the operator can anticipate and prevent trouble.

Steel Drum Gears- for HOISTING ENGINES

Your gear requirements may never call for hoisting engine steel drum gears to pull freight cars—for which purpose Stahl manufactured the gears illustrated. However, for any gear problems, in any size or quantity, it will more than pay to get that next estimate from Stahl.

SPURS TO 72" PD, 1 DP
BEVELS TO 54" PD, 1 DP
SPIRAL, HELICAL and WORM GEARS TO 48" PD, 2 DP
CONTINUOUS-TOOTH HERRINGBONE TO 60" PD, 2 DP
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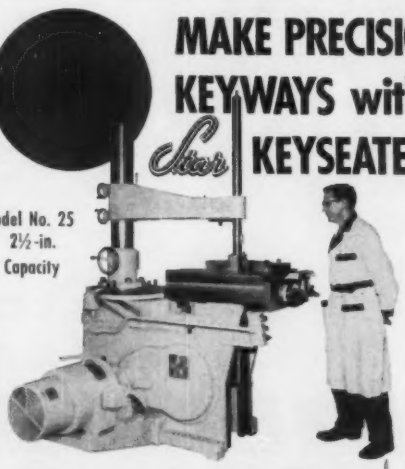
SILENT GEARS: RAWHIDE, BAKELITE, FIBROIL
HEAT-TREATED, CASE OR FLAME HARDENED GEARS — OF CARBON OR ALLOY STEEL

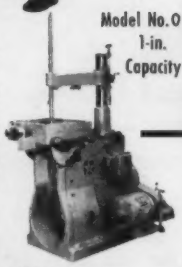
Stahl
GEAR & MACHINE COMPANY
3901 Hamilton Ave. Cleveland 14, Ohio

For more data circle Item 240A

MAKE PRECISION KEYWAYS with Star KEYSEATERS



Model No. 25
2½-in.
Capacity



Model No. 0
1-in.
Capacity

Versatile, heavy-duty Star machines produce precision keyways in a minimum of time. Proven overarm bushing support and motorized pull-down reciprocating cutter bar action assures maximum keyway accuracy and alignment. Wedge-locked H.S.S. form tools in stock sizes from 1/8-in. to 3-in. width fit seven standard bar sizes up to 2-7/16-in. diameter. Stroke adjustable up to 24-inches. Automatic work table feed and backoff. Tilting table. Overarm column movable for cutting keyways opposite spokes.

Star Cutter Company
34500 Grand River Blvd. • Farmington, Michigan

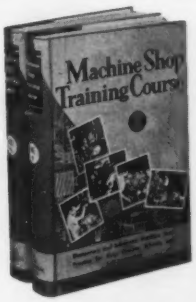
For more data circle Item 240B

Classified and Resale Section

CLASSIFIED ADVERTISING RATES: $16 per single column inch

MACHINE SHOP TRAINING COURSE

By Franklin D. Jones



This standard treatise on machine shop practice is in two volumes which may be used independently, but which together contain the most complete existing work on machine shop practice and allied subjects.

MACHINE SHOP TRAINING COURSE contains over 1000 pages of questions and answers, carefully selected to deal with the most important elements of machine shop practice, and with other subjects closely allied to work in the shop. The answers in each case cover clearly and fully the essential points, and average about one book page in length. They are packed with useful facts and shop rules, and are accompanied by clear drawings and photographs whenever needed.

This is for the shop man who wants to supplement his own experience with a broad fund of practical knowledge, for use as a textbook and guide in shop training courses, for technical or trade schools, for designers and production engineers who want the fundamentals of machine shop practice and for mechanical engineering students.

Vol. I 570 Pages, $5.50
Vol. II 554 Pages, $5.50
Complete Two Volume Set $9.00
To Order, See Last Page

eastern Rebuilt Machine Tools

THE SIGN OF QUALITY

THE MARK OF DEPENDABILITY

The listing below is only a VERY SMALL AMOUNT of the total number of machine tools that we have in stock for immediate shipment. Our prices are realistic with today's market and our quality of rebuilding is the same high standard—THE LEADER IN THE FIELD OF REBUILT MACHINE TOOLS.

AUTOMOTIVE GRINDERS
No. 76 Van Norman Automatic Piston Turning & Grinding Machine, m. d.
Kwik-Way Model H Piston Turning & Grinding, m. d.

CENTERLESS GRINDERS
No. 2 Cincinnati, Filmatic
No. 3 Cincinnati, m. d.

CRANKSHAFT GRINDERS
22x72" Landis Type CH, m. d. late

CYLINDER GRINDERS
No. 50 Heald, m.d., 1945
No. 73 Heald Airplane Cylinder, m. d. new
No. 78 Heald Centerless Cylinder, m. d., 1944

EMERY GRINDERS
Type 10 BAP, Model 100 Standard Elec. Tool, new
Type 36 FAS, Model 102 Standard Elec. Tool, new
Type 24 FAS, Model 101 Standard Elec. Tool, new
48" Double End U. S. Electrical Co. Buffer
No. 5D Gardner H. D. Polishing Stand, 1948

DISC GRINDERS
No. 121 Hanchett Prod. Face Grinder, m. d.
Model 342—30 Besly, vee belt, m.d. 1945
Model 75 Queen City Double Wheel, m. d. 1944

MULTIPLE SPINDLE DRILLS
Model #E5 Natco Multiple Spindle H.S. Drill Press
2 spindle No. 201¼ Barnes, m. d., H.D.
2 spindle No. 6 Colburn Mfg. Type H.D., separate m.d. to each spindle
4 spindle No. 201¼ Barnes H.D., m. m.d.
6 spindle Barnes, m.d.
6 spindle W.F. & John Barnes Vertical Drilling Machine, m. d.
No. 924 Barnes Vertical Boring, Drilling, Facing & Reaming Machine

UPRIGHT DRILLS
Model H4 Barnes Hydram, m. d.
20" Barnes, m. d. 1940
20" Barnes All Geared Self-Oiling Drill & Tapper, m. d.
21" Cincinnati-Bickford, single spindle, m. d.
21" Cincinnati-Bickford, H. D., m.d. late
28" Cincinnati-Bickford, H. D.
No. 2 AL Natco Holesteel Vertical, m. d.
No. 201¼ Barnes Single Spindle Upright Drill & Tapper, m. d.
No. 314A Baker Universal Quick Change Type, m. d. H.S.
No. 513 Baker, m.d., belted m.d.

GEAR GRINDING MACHINES
6x20" Fitchburg Hydraulic Spline & Gear, m. d.
GG19 Gear Grinding, m.d. latest
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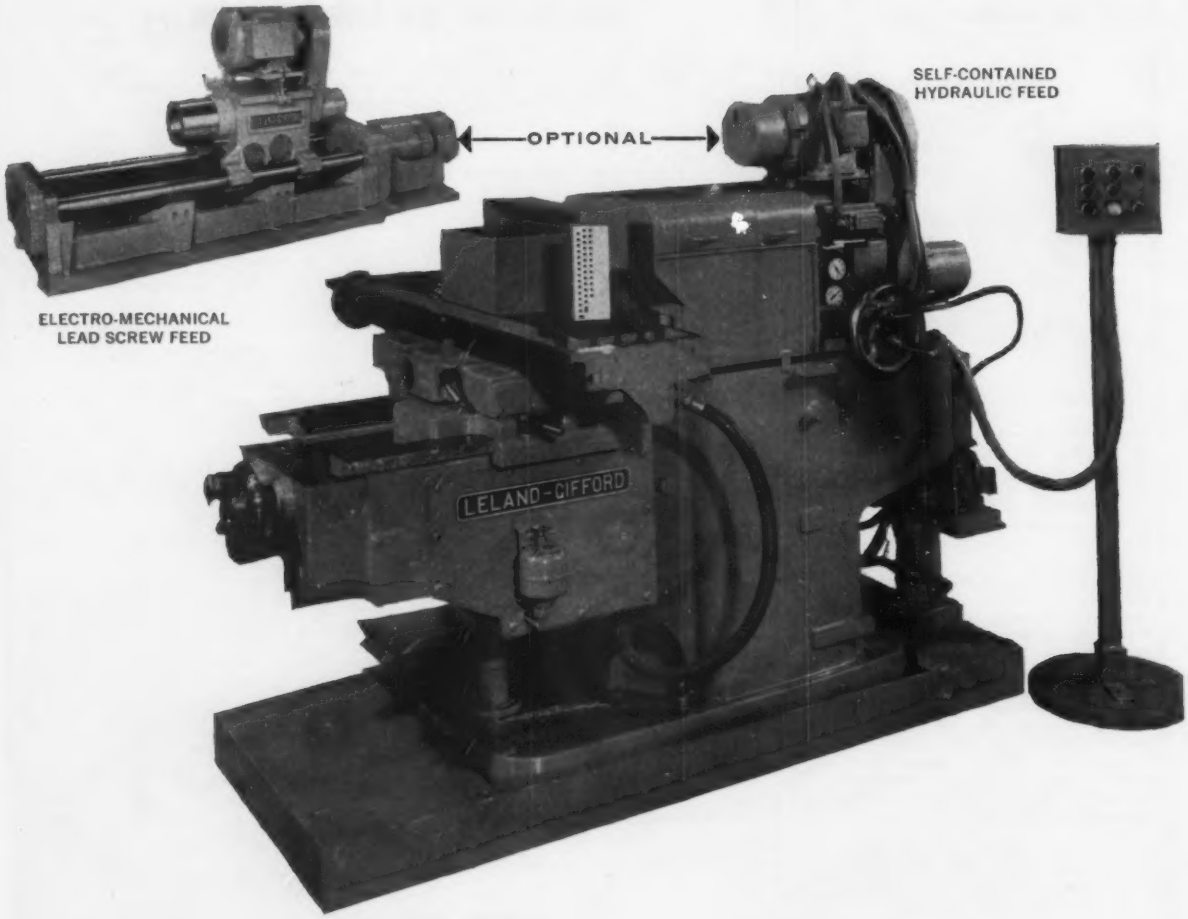

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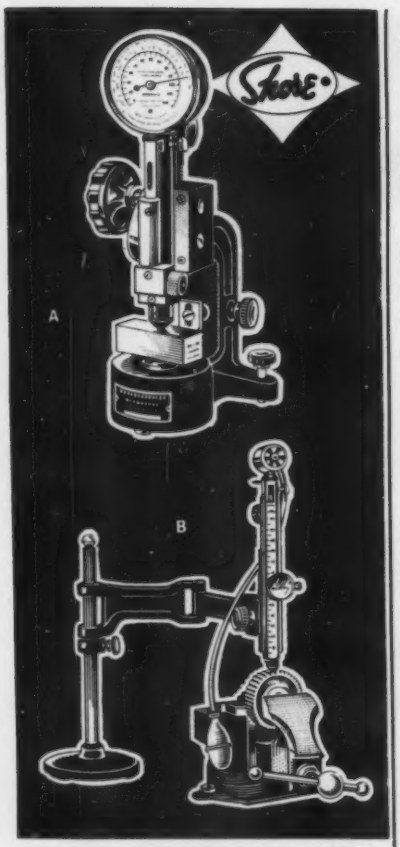

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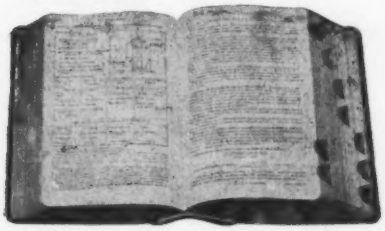

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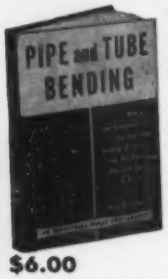

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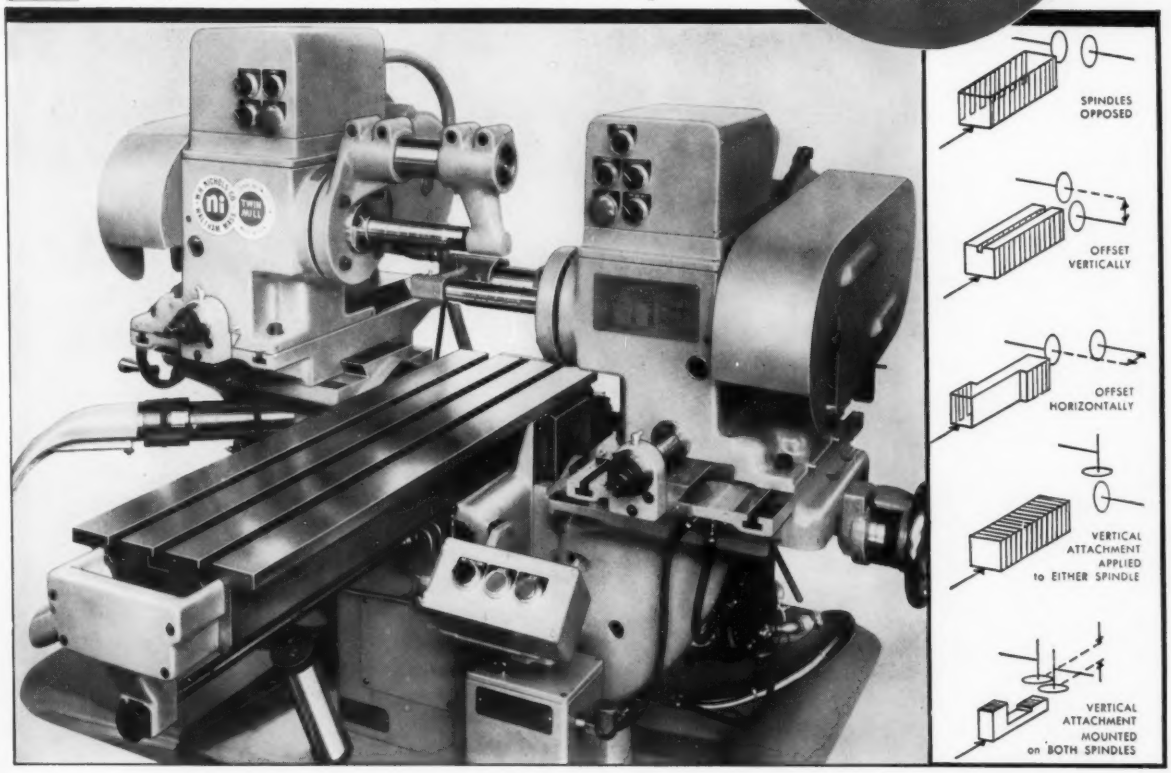

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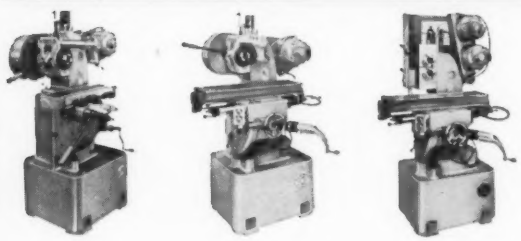

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